3030A PowerProfiler™ User's Guide

BMI

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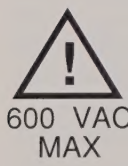
3030*A* PowerProfiler User's Guide



This symbol indicates maximum input voltage to instrument not to exceed 600 Vrms.

Protective ground (earth) terminal.

WARNING!

The installation instructions in this manual are for use by qualified personnel only. *Do not install this instrument on a power line unless you are qualified to do so.* High voltages that cause burns and lethal shocks are present during power monitoring. *When making connections to power lines, always connect the safety earth ground first. Use standard high-voltage, high-current safety precautions.*

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FCC Requirements

FCC Part 68 Registration

This equipment may have a modem installed for remote operation over the telephone lines. This modem is registered with the FCC and complies with Part 68 of the FCC rules. Connection of this equipment to the public-switched telephone network is regulated by the FCC and these regulations require the following:

1. Connection of the modem in this equipment to party lines and pay telephones is prohibited.

2. If requested, the following information concerning the modem must be made available to the telephone company:

   Modem Manufacturer:
   OmniTel, Inc.
   3500 West Warren Ave.
   Fremont, CA 94538

   Model No.: 2400i+ –001

   FCC Registration:
   D768JC–13819–DM–E

   Ringer Equivalence (REN): 1.3B

   Telephone No.:
   The telephone number to which the modem is connected.

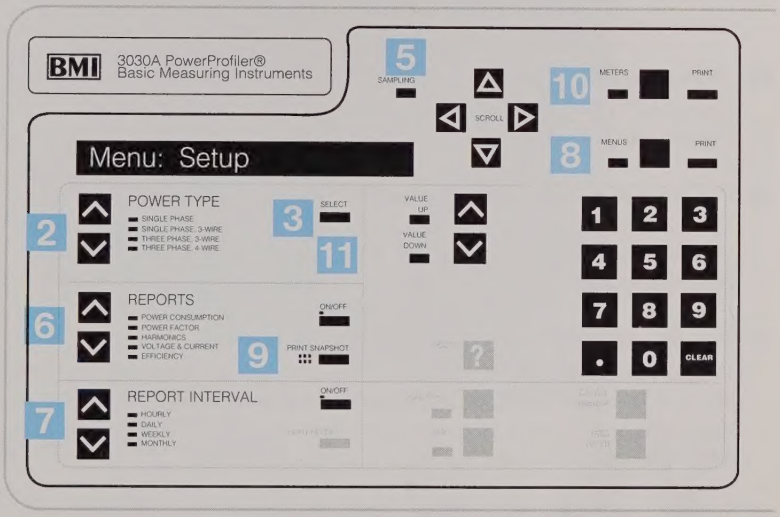
3. The REN is used to determine the quantity of devices which may be connected to the telephone line. Excessive REN's on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the REN's should not exceed five (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total REN's, contact the telephone company to determine the maximum REN for the calling area.

4. If the modem causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the telephone company will notify you as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

5. The telephone company may make changes to its facilities, equipment, operations, or procedures that could effect the operation of this equipment. If this happens, the telephone company will provide advance notice in order for you to make the necessary modifications in order to maintain uninterrupted service.

6. If telephone trouble is experienced during or after the connection of the modem, disconnect the modem from the line and see if the problem ceases. If it does, then the modem is causing the problem. In this case, please contact OmniTel Technical Support at **(415) 490-2202** for repair and warranty information. If the trouble is causing harm to the telephone network, the telephone company may request that you remove the equipment from the network until the problem is resolved.

7. The manufacturer (OmniTel) must make any necessary repairs to the modem in order to maintain valid FCC registration. Do not attempt to repair or service the modem other than to return it to BMI who will arrange for service from OmniTel.



1 Plug in your PowerProfiler and turn it on.
The On/Off (I/O) switch is on the rear of the unit.

2 Select the power type.
Press the **UP/DOWN** arrows until your selection flashes.

3 Press the SELECT button to choose the power type.

4 Connect SmartProbes and voltage cables to power lines.
For more information turn to Chapter 3, "Connecting to Power."

5 Check that the SAMPLING light flashes green.
If it flashes red, you're not connected correctly. If it flashes orange, you may or may not be connected correctly. Press the **METERS** button, then press **HELP**. Or turn to Chapter 3, "Connecting to Power."

6 Print a Voltage & Current snapshot to verify your setup.
Press the **UP/DOWN** arrows in the **REPORTS** section until **VOLTAGE AND CURRENT** is flashing. Then press **PRINT SNAPSHOT**. Check these

to verify that you are connected correctly. See Chapter 3 for an explanation of phasor diagrams.

7 **Choose the desired reports.**
Use the **UP/DOWN** arrows in the **REPORTS** section to get your selection flashing, then press the **ON/OFF** button. Repeat for each report you want.

8 **Choose the desired report interval.**
Use the **UP/DOWN** arrows in the **REPORT INTERVAL** section to get your selection flashing, then press the **ON/OFF** button. Repeat for each report interval you want.

9 **Press the MENUS button and choose the Setup Menu.**
Press the **SCROLL DOWN** arrow to scroll through the Setup Menu. Use the **VALUE UP/VALUE DOWN** buttons and the alpha/numeric keypad to enter date, time, and all other setup questions. Press the **PRINT** button next to the **MENUS** button to print a full list of your menu settings.

10 **Press the METERS button to get meter readings.**
Use the **SCROLL** buttons to scroll through the meter readings. Press the **PRINT** button next to the **METERS** button to print a list of meter readings.

11 **Clear accumulated data (optional).**
If you want to clear all data accumulated during setup, press **SELECT** and hold for two seconds. Answer "yes" by pressing the **SCROLL DOWN** arrow. For more information on clearing data and settings, see Chapter 3.

WARNING! You are working with high voltages that cause burns and lethal shocks. Connect the safety ground first. *Use standard safety precautions.*

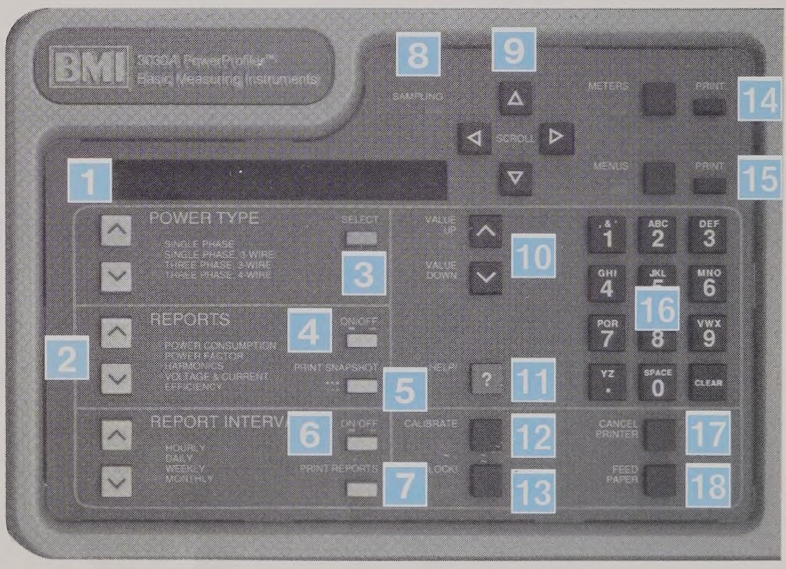
The 3030*A* PowerProfiler

The PowerProfiler measures and describes all aspects of your power consumption including power demand, cost, and harmonics. From a single load to an entire building, the PowerProfiler accurately measures power for any type of power system or load.

All PowerProfilers are capable of measuring single- and three-phase systems. A high resolution thermal printer, RS-232 port, and four environmental channels are standard. This User's Guide, a complete set of voltage monitoring cables, and five rolls of paper are shipped with every unit.

Your PowerProfiler is comprised of a hardware unit with base level firmware and possibly one or more of the Option Packages (depending upon the packages ordered with, or added to, your unit). Each Option Package adds measurement power to your unit to help meet your requirements.

2 About Your PowerProfiler



3030A Front Panel (Left side)

1 **Display Window** - shows meter readings, menus.

2 **UP/DOWN Arrows** - moves you through selections (causing LED to blink).

3 **SELECT** - enters your selected power type (flashing LED becomes solid).

4 **ON/OFF** - turns the chosen report on (solid green LED) or off (flashes red then turns off).

5 **PRINT SNAPSHOT** - prints an instantaneous snapshot of the reports turned on, or of any single report with a flashing LED.

6 **ON/OFF** - turns the chosen report interval on (solid green LED) or off (flashes red then turns off).

7 **PRINT REPORTS** - prints chosen reports gathered since last scheduled report interval.

◆ *Press the Help! button at any time for more information*

SAMPLING Light - Flashes green when unit is connected correctly and sampling. Flashes orange or red if not connected properly. See Chapter 3 for full descriptions of the green, orange, and red lights.

SCROLL Arrows - use to scroll through menus and meters shown in the display window.

VALUE UP/VALUE DOWN - scroll through menu choices.

HELP! - Press at any time for useful advice, descriptions of problems, or the range of values the unit will accept.

CALIBRATE - prints a Calibration Report. **CALIBRATE** then **SCROLL UP** arrow accesses Calibration Menu.

LOCK - locks and disables front panel buttons. **LOCK** then **CLEAR** unlocks front panel.

METERS - displays meter readings in display window.
PRINT - prints all meter readings at time of request.

MENUS - displays menus in display window.
PRINT - prints menu settings.

Alpha/Numeric Keypad - enter letters and numbers in menu selections.

CANCEL PRINTER - cancels the message, report, or snapshot currently printing. **CANCEL PRINTER** followed by **SCROLL UP** arrow resets unit, but does not clear any accumulated data, or change the configuration.

FEED PAPER - advances paper.

See page 2-4 for the description of the right side front panel with standard paper takeup, and page 2-5 for the description of the right side front panel with optional diskette drive.

About Your PowerProfiler

3030A Front Panel (right side) with Standard Paper Takeup

- **Printer Door Release** - opens door for paper loading and removal.
- **Takeup Slot** - feed paper through slot to attach to takeup spool.
- **RUN/LOAD Lever** - engages and releases printer paper roller (See page 4-8 for information on loading paper).

3030A Front Panel (right side) with Optional Diskette Drive

1. **Disk Activity Indicator Lights** - show diskette drive status. **IDLE** - drive not in use. **RECORD** - all reports and messages will be recorded to the diskette. **PLAYBACK** - data stored on diskette will be output to printer. **INITIALIZE** - diskette in drive will be initialized (formatted), erasing all data on the diskette. **EMPTY/FULL** - indicates space used on diskette (blinking red LED indicates locked, damaged, or unusable diskette).

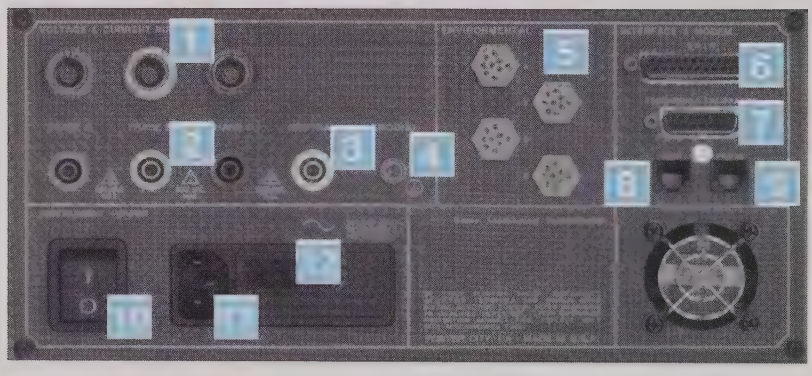
2. **Diskette Drive** - formats, reads and writes 720 kB 3.5" diskettes (DS DD disk only).

3. **Printer Door Release** - opens door for paper loading and removal.

4. **RUN/LOAD Lever** - engages and releases printer paper roller (See page 4-8 for information on loading paper).

IMPORTANT: Use only double-sided, double-density diskettes.

About Your PowerProfiler



3030A Rear Panel

1. **SmartProbe Current Inputs** - accepts BMI SmartProbe connectors (See chapter 8 for more information).
2. **Voltage Safety Connectors** - accepts BMI voltage monitoring cables.
3. **Neutral Voltage Connector** - accepts BMI netural voltage monitoring cable.
4. **Ground Connector** - accepts BMI ground monitoring cable.
5. **Environmental Connectors** - acccepts BMI environmental probes (See chapter 8 for more information).
6. **RS-232 Port** - accepts RS-232 cable; connects to DOS compatible PC, another PowerProfiler, or an external modem.
7. **Expansion** - accepts BMI accessories and future enhancements.
8. **LINE** - accepts RJ-11 phone line connector when optional internal modem (Communications Option G-206) is installed.
9. **PHONE** - connection for telephone handset.
10. **I/O** - turns unit power on and off.

Power Input - accepts AC power cord.

Supply Voltage - sets the Supply Voltage Setting to either 120 Vac or 240 Vac.

Input Voltage Operating Ranges

	Setting			
Frequency	100V	120V	220V	240V
50 Hz	N/A	100-120V	220-277V	195-240V
60 Hz	N/A	100-140V	220-277V	195-277V
400 Hz	N/A	105-160V	230-277V	200-277V
Use fuse rated:	**N/A**	**2A**	**1A**	**1A**

About Your PowerProfiler

Base Configuration and Option Packages

PowerProfiler Base Package
The standard instrument can measure the following parameters:

- true RMS voltage
- true RMS current
- voltage and current imbalance
- true power (W)
- apparent power (VA)
- reactive power (VAR)
- true power factor (PF)
- displacement power factor (dPF)
- phase relationship between fundamental voltage and fundamental current
- voltage and current total harmonic distortion (THD)
- frequency

These measurements are displayed real-time in the display window. Simply press **METERS** and use the **SCROLL** arrows to view each value. Pressing the **PRINT** button beside the **METERS** button will print a complete list of all parameters and their values at the time of the request. The standard paper take up system keeps these printouts rolled neatly.

The base package does not provide any graphics capability, except for the phasor diagrams in the Voltage & Current Snapshot. No reports or additional snapshots can be printed. If the Graphics Option Package is not installed and you request a report (**PRINT REPORTS** button) or snapshot (**PRINT SNAPSHOT** button), one of the following messages will print:

"You must add P-304 Graphics Option Package to use interval reports."
"You must add P-304 Graphics Option Package to get additional snapshots."

More useful monitoring information is available through the use of Summaries. Summaries will provide information on true power (W) and power factor (PF) only, or on all measured parameters (based on which Reports are selected) over a user selected interval between 1 and 60 minutes. The data can be printed, stored on the optional diskette drive, or sent to a PC running PowerTalk software through the RS-232 port. This data can be entered into any standard spreadsheet program either manually or by using PowerTalk Export. See Chapter 6 for more about Summaries and Chapter 7 for more on PowerTalk and Export software.

Graphics Option Package P-304

By installing this package in your PowerProfiler you add easy-to-read, high-resolution graphics to your reports. Since the PowerProfiler is intended for field use, it can process all of its measured data into graphical representations for fast, accurate interpretation. Reports are graphical summations of specific data over user selected intervals of one hour, one day, one week, and one month. Reports and the report intervals are separate from Summary type and Summary interval found in the Setup Menu. Information on one report may be found in any or all of the report intervals. When this package is added to the base unit, the following reports become accessible:

- Power Consumption Report
  - instantaneous power (W)
  - instantaneous volt-amps (VA)
- Power Factor Report
  - volt-amps reactive (VAR)
  - true power factor (PF)
  - displacement power factor (dPF)
- Harmonics Report
  - voltage THD
  - current THD
- Voltage & Current Report
  - voltage
  - current
  - frequency

In addition to the graph, each report gives the interval, the date, the minimum and maximum values during the interval, and the minimum and maximum values since the last time the data was cleared. See the Option Overview Chart for an overview of what this option provides.

For every report there is also a Snapshot. Unlike reports which are gathered over time, snapshots are real time glimpses at what is happening on the power system. They can be easily requested in the report section of the front panel. Use the **UP/DOWN** arrows to get the LED beside the desired snapshot blinking (either red or green), then press **PRINT SNAPSHOT**. If no lights are flashing, pressing the **PRINT SNAPSHOT** button will print out snapshots for all reports which are turned on. Adding the Graphics Option to the base unit will provide the following snapshots:

1-408-
970-370

- Power Consumption Snapshot
  - power profile graphs
- Power Factor Snapshot
  - text information on:
    - watts (W)
    - volt-amps (VA)
    - volt-amps reactive (VAR)
    - true power factor (PF)
    - displacement power factor (dPF)
- Voltage & Current Snapshot
  - text information on all voltages
  - text information on all currents
  - voltage phasor diagram (except Single Phase power type)
  - current phasor diagram (except Single Phase power type)
  - voltage and current waveshape graphs for all phases

NOTE! It is important to note that the Graphics Option Package P-304 is needed to obtain the full report and snapshot capabilities of the PowerProfiler. The Neutral Option P-303, the Harmonics Option P-302, and the Demand Option P-301 may be installed without the Graphics Option to expand the measured parameters in the Summary data, but their respective reports and snapshots will not be available. See Chapter 6 for more information.

Neutral Option Package P-303

The Neutral Option Package measures the actual neutral-to-ground voltage while you monitor any power type (except three-phase, three wire). Based on the magnitude and phase relationships of each current, it will also calculate the neutral current according to:

$$I_A + I_B + I_C + I_N = 0$$

When this option is used with the Harmonics Option Package P-302, you can obtain a harmonic spectrum analysis for the neutral current.

The Neutral Option adds the following reports to the base unit:

- Harmonics Report
  - neutral current THD

- Voltage & Current Report
  - neutral-to-ground voltage
  - neutral current

The snapshot capability is also enhanced by adding neutral-to-ground voltage and neutral current to all facets of the Voltage & Current Snapshot.

Harmonics Option Package P-302
This option provides voltage and current harmonic spectrums and spectral graphs up to the 50th harmonic (for 60 Hz systems). The power, in watts, at each harmonic and its direction of flow is also provided. Harmonic information may be presented in one of four user-selected formats:

- % of Fundamental
  - THD, North American convention
- % of Max. Load Current
  - TDD, IEEE 519 recommendation
- % of RMS
  - thd, European convention
- Actual Volts and Amps

Four individual harmonics can be identified for display in meters and reports.

The Harmonics Option Package adds the following reports and snapshots:

- Harmonics Report
  - up to four individual harmonics chosen by user
- Harmonics Snapshot
  - text information on voltage and current distortion
  - voltage spectum and spectral graph
  - current spectrum and spectral graph
  - harmonic power spectrum
  - neutral current spectrum and spectral graph (if Neutral Option P-303 is installed)

About Your PowerProfiler

From this harmonic information three more parameters are determined for meter display. First, for the voltage and current waveforms, the percentage of positive, zero, and negative sequences is provided. Second, based on ANSI C57.110, the transformer derating percentage is calculated. And third, from data in IEEE 519, the I*T Product is determined. Each of these items, what they mean, and their importance is discussed in greater detail in Chapter 6 and in the Glossary.

Demand Option Package P-301
This option provides cash flow and billing demand interval calculations and reports. In the Rate Structure Menu you can enter your billing demand interval and utility rate structure to measure your consumption and cost (in different currencies) the same way that the utility meters your power. As with all reports, information from the Demand Option will give you the minimum and maximum readings over your interval and since the data was cleared last. Power consumption is now monitored over time as watt-hours, or more typically, kWh. Menus and meters are updated to include the percent capacity based on user-defined maximum capacity and units. Efficiency can also be measured when using two PowerProfilers, both with this option. Savings can be easily calculated when considering more efficient equipment, or increasing the efficiency of existing machines.

The Demand Option adds the following reports and snapshots:

- Power Consumption Report
  - billing demand
  - load duration curve
  - cash flow
  - text on total consumption
- Efficiency Report
- Efficiency Snapshot
  - text on efficiency at time of request

Disk Drive Option Package P-360
This option replaces the standard paper take up system with a 3.5" DOS compatible, 720 kB diskette drive (DS DD disks only). No additional options need to be installed to use the diskette drive. The drive is controlled via the Storage Menu. All data, in its processed form, can be stored on diskette with or without printing on the internal printer. Stored data can be played back to the printer, played back over a remote communication link, or viewed on a 286 or 386 PC

running Windows and BMI's PowerTalk software. PowerTalk is discussed more in Chapter 7, and is included with the purchase of this option.

Communications Option Package G-206

The PowerProfiler comes standard with an RS-232 port for communicating with external devices. This option provides an internal modem as an additional method of communication. The Communications Menu is updated to allow the user to choose the internal modem as the desired port. The internal modem is Hayes compatible, auto-answer, auto-dial, and has a user defined baud rate of 300, 1200, or 2400 baud. Chapter 7 will discuss more of the modem and its operation.

Option Overview Chart

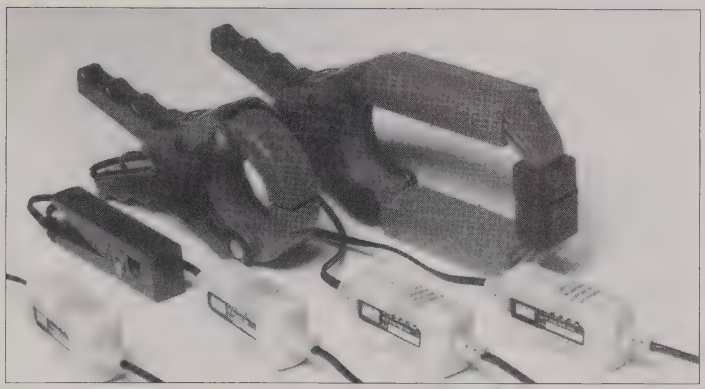
The following chart summarizes each option and what features and enhancements it adds to the Base Unit.

About Your PowerProfiler

Option Overview Chart

Configuration	Meters *	Menus	Snapshots	Reports
Base Unit	Volts, amps, imbalance, watts VA, VAR, PF, dPF current lead/lag V THD, I THD, freq.	Setup Set threshold Communications	Voltage & Current • text on V and I • phasor diagrams	None
Graphics P-304			Power Consumption • total power profile • phase power profile (Wye only) Power Factor • text on W, VA VAR, PF, dPF Voltage & Current • V & I waveshapes	PowerConsumption • instantaneous W • instantaneous VA Power Factor • instantaneous VAR • PF, dPF Harmonics • V & I THD Voltage & Current • V, I, Freq.
Neutral P-303	N-G voltage Neutral current Neutral current THD		Voltage & Current • text on N-G volt. & N current • waveshapes	Harmonic • N current THD
Harmonics P-302	V & I sequencing transformer derating I*T Product, indiv. harmonics	Harmonics	Harmonics •V & I spectrum and spectral graphs •power spectrum and direction •N current spectrum (if P-303 added)	Harmonics • individual harmonics
Demand P-301	Percent capacity Efficiency Cost	Rate Structure Adds Capacity and Units to Setup Menu	Efficiency snapshot	Power consumption • billing demand • load duration curve • cash flow • text on kWh, Qh Efficiency report
Disk Drive P-360		Storage		
Communications G-206		Adds internal modem to Communications		
Environmental Probes	Probe parameters	Environmental		Probe reports printed after selected reports for same interval

* These metered parameters are available in Summaries based on which Reports have been selected. See Chapter 6 for more information on Summaries.



BMI SmartProbes from left to right: A-115, A-116, and A-120. Not pictured is the A-121.

This chapter shows you how to connect your PowerProfiler. It lists all the cables and probes you'll need, describes how to connect to all types of power, and shows you graphs to help you check your connections.

Checklist of cables and probes you will need:

- Single-phase
  - 1 SmartProbe, 1 voltage cable, 1 ground cable, 1 neutral cable
- Single-phase, phase-to-phase
  - 1 SmartProbe, 2 voltage cables, 1 ground cable
- Single-phase, 3 wire
  - 2 SmartProbes, 2 voltage cables, 1 ground cable, 1 neutral cable
- Three-phase, 3 wire (Δ)
  - 2 or 3 SmartProbes, 3 voltage cables, 1 ground cable
- Three-phase, 4 wire (Y)
  - 3 SmartProbes, 3 voltage cables, 1 ground cable, 1 neutral cable

WARNING! You are working with high voltages that cause burns and lethal shocks. Connect the safety ground first. *Use standard safety precautions.*

Connecting to Power

Connect to Power

Find the number of phases.
Count the number of current carrying conductors. Count the neutral conductor if you find one, but don't count the ground or earth conductor.

One Conductor – This isn't possible. You must have more than one current carrying conductor; otherwise no power can flow. Count again.

Two Conductors – Single-phase (phase-to-phase or phase-to-neutral)

Three Conductors – You have either three-phase 3 wire or single-phase 3 wire. If you're not sure, connect your PowerProfiler for three-phase 3 wire. Print a voltage snapshot. Compare your voltage phasor diagram to the ones on pages 3-7 through 3-10 to find which type of power you have.

Four Conductors – You have three-phase 4 wire.

Five Conductors – You've counted wrong (don't count the ground wire), or you have more than one power system, or your power has more than three phases. Try again (it is unlikely that you would have more than three phases).

Set the power type.
Use the **UP/DOWN** arrows to get the LED next to your selection blinking. Press **SELECT** to set that power type.

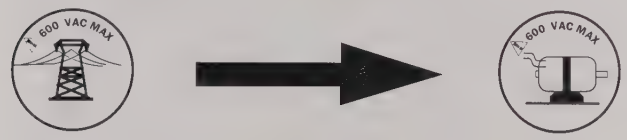
Connect the voltage cables. Always connect to the unit first, then to the power system.
- Connect the ground cable first.
- Connect the neutral cable (if there is one).
- Connect the voltage phase lead(s). (See table below and the connecting diagrams on pages 3-4 through 3-6.)

Single-Phase	Single-Phase (phase-to-phase)	Single-Phase 3 wire	Three-Phase 3 wire	Three-Phase 4 wire
Ground	Ground	Ground	Ground	Ground
Neutral	Phase A	Neutral	Phase A	Neutral
Phase A	Phase B	Phase A	Phase B	Phase A
		Phase B	Phase C	Phase B
				Phase C

Color code SmartProbes with colored O-rings.
Make sure SmartProbes are color-coded to match by phase with the voltage cables. Slip the large O-ring onto the descriptor module and the small O-ring onto the connector.

Connect the SmartProbes to current inputs.

- Make sure SmartProbes correspond by phase to the voltage cables. See Figures 3.1 to 3.5. You can also use phasor diagrams to verify connections (see pages 3-7 to 3-10).
- Clamp the SmartProbes on conductors matching the direction of power flow — from source to load.



6 Verify your voltage and current connections.
These color codes are often, but not always, followed. Use them only as a guide.

Location	Voltage	Phase A	Phase B	Phase C	Neutral	Ground
USA	120	black			white	green/bare
USA	120/208	black	red	blue	white	green/bare
USA	480	brown	orange	yellow		green/bare
USA	distrib.	black	white	red		
Int'l.	single-ph	brown			blue	green/yellow
Int'l.	three-ph	red	yellow	blue		green/yellow
PowerProfiler back panel		red	yellow	blue	white	yellow/green

WARNING! You are working with high voltages that cause burns and lethal shocks. Connect the safety ground first. *Use standard safety precautions.*

Connecting to Power

Figure 3.1: Single-Phase Connection Diagram.

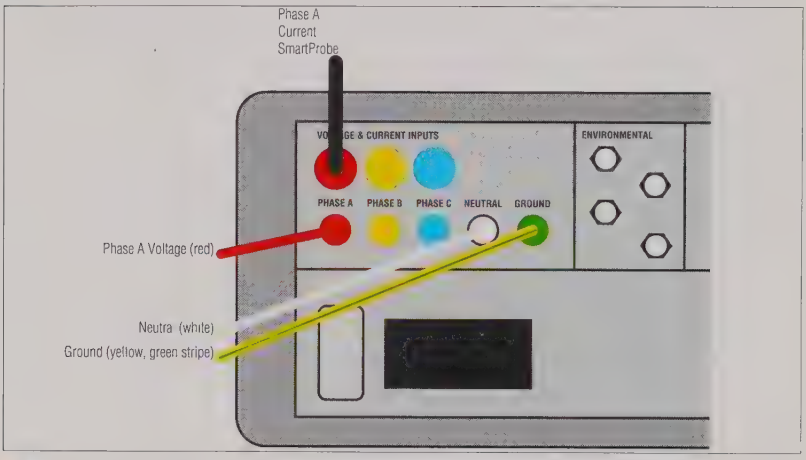
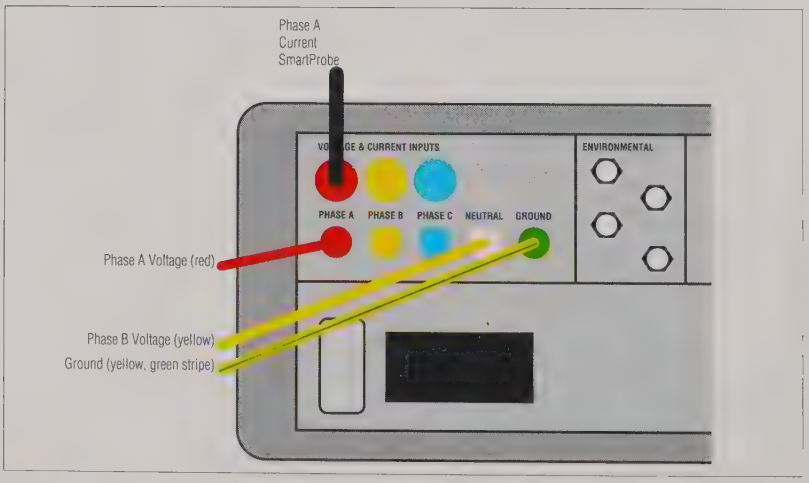


Figure 3.2: Single-Phase Phase-to-Phase Connection Diagram.



NOTE! This connection will provide high neutral-to-ground voltage measurements. Measurements will be labeled as "A-N".

Figure 3.3: Single-Phase 3 Wire Connection Diagram.

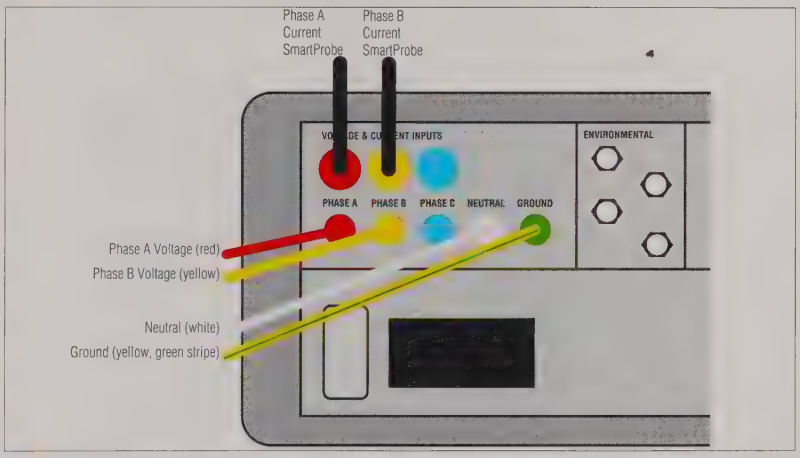
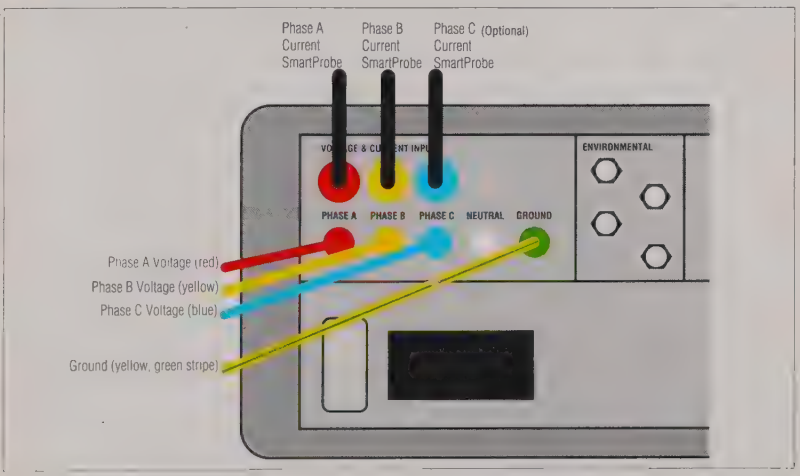
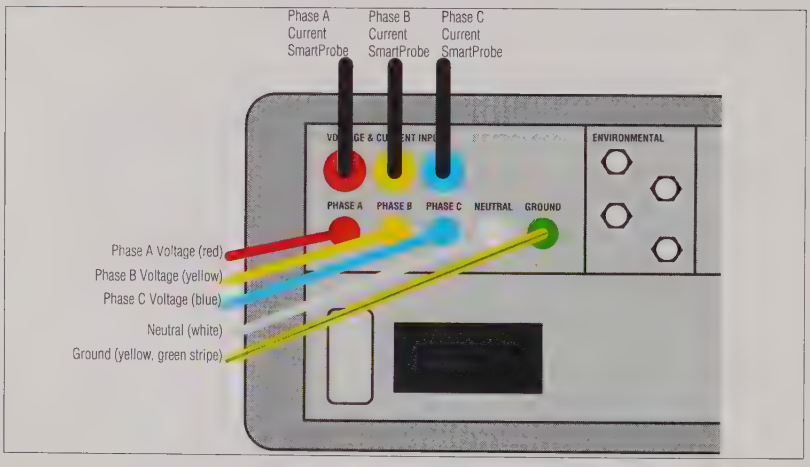


Figure 3.4: Three-Phase, 3 Wire (Δ) Connection Diagram.



Connecting to Power

Figure 3.5: Three-Phase, 4 Wire (Y) Connection Diagram.



Verify Your Connections

Check the SAMPLING light. The light flashes in color to indicate condition.
Green – Reasonable voltages, currents, and phase relationships exist for the chosen power type. There is an acceptable signal to phase-lock onto.
Orange – Unit is phase-locked but one or more of the following exists:

- Single-phase
  - no current in Phase A
  - Phase A watts <0
- Single-phase, 3 wire
  - no current in Phase A and/or Phase B
  - Phase A or Phase B watts <0
  - Phase A or Phase B dPF <0.3
- Three-phase, 3 wire (Δ)
  - no current on any two phases
  - voltage or current negative sequence >50%
  - Any phase watts <0
- Three-phase, 4 wire (Y)
  - no current on one phase
  - voltage or current negative sequence >50%
  - any phase watts <0
  - any phase dPF <0.3

Red – Either the connections don't match the chosen power type or there is no appropriate signal to phase-lock to.

- **Print a phasor diagram.** (Best choice for single-phase, 3 wire, and three-phase.) Select **VOLTAGE & CURRENT** in the report section of the front panel. When the LED is flashing, press **PRINT SNAPSHOT**. This will print the phasor diagrams. These will help you tell if you are correctly connected. Refer to sample diagrams beginning on this page.

- **Use *HELP!* messages.** (Best choice for single-phase.) Press the **METERS** button, then press ***HELP!***

Phasor Diagrams

Use these samples of correct and incorrect phasor diagrams to verify your connections (Figures 3-6 through 3-17).

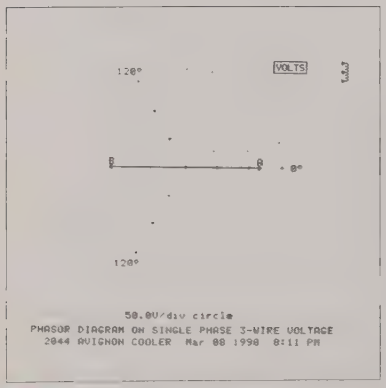


Figure 3.6: Correct Voltage Connection for Single-Phase 3 Wire.

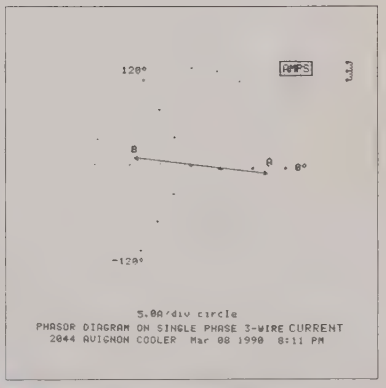


Figure 3.7: Acceptable Current Connection for Single-Phase 3 Wire.

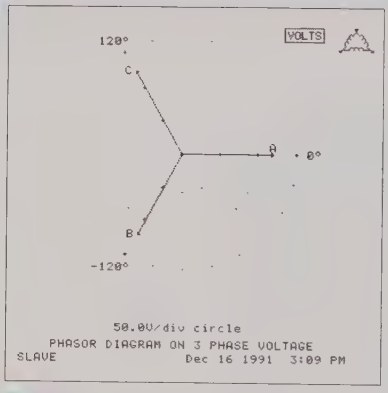


Figure 3.8: Correct Voltage Connection for Three-Phase 3 Wire (Δ).

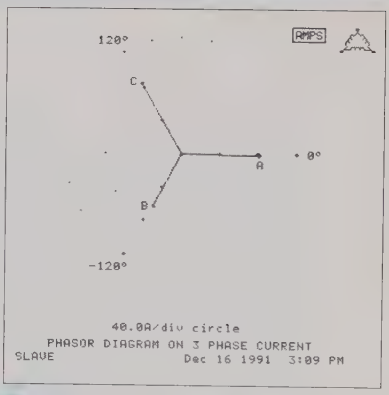


Figure 3.9: Acceptable Current Connection for Three-Phase 3 Wire (Δ).

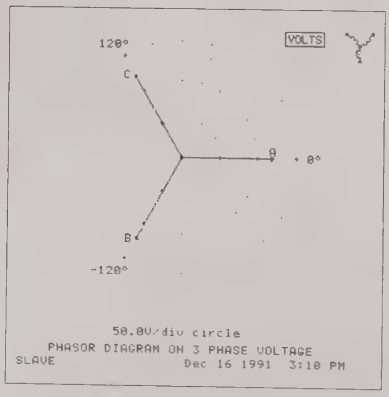


Figure 3.10: Correct Voltage Connection for Three-Phase 4 Wire (Y).

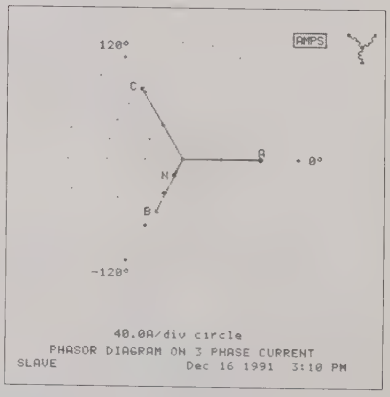


Figure 3.11: Acceptable Current Connection for Three-Phase 4 Wire (Y).

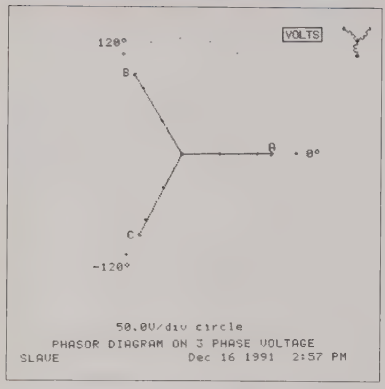


Figure 3.12: Incorrect Voltage Connection for Three-Phase 4 Wire (Y). Reversed connection/phase.

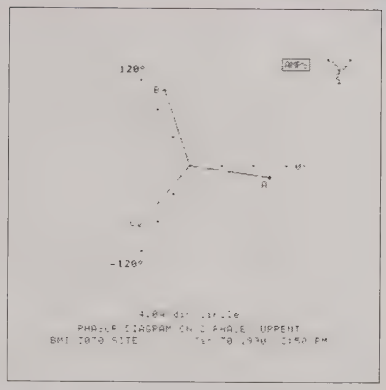


Figure 3.13: Incorrect Current Connection for Three-Phase 4 Wire (Y). Reversed connection/phase.

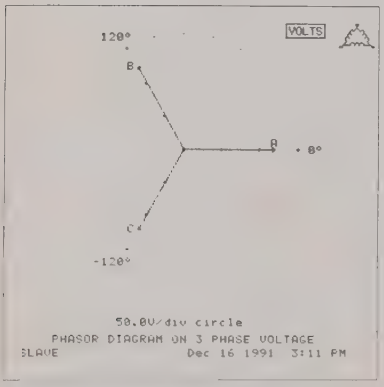


Figure 3.14: Incorrect Voltage Connection for Three-Phase 3 Wire (Δ). Reversed connection/phase.

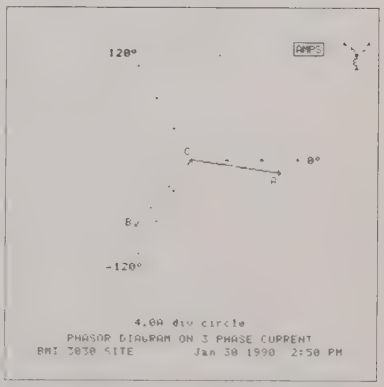


Figure 3.15: Incorrect Current Connection for Three-Phase 4 Wire (Y). Missing phase.

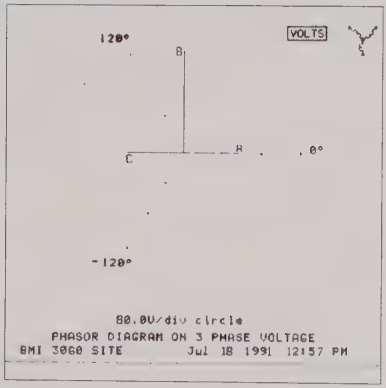


Figure 3.16: Unique Three-Phase 3 Wire (Δ) Voltage Connection.
Hot-leg Δ.

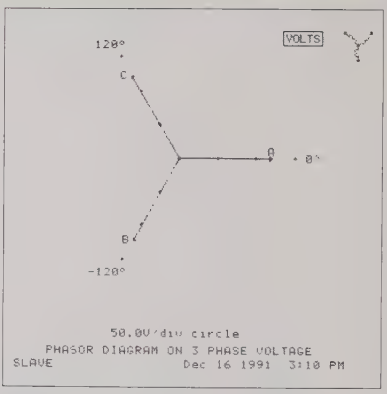


Figure 3.17: Unique Three-Phase 4 wire (Y) Voltage Connection.
Open neutral.

Clearing Accumulated Data and Settings

To clear accumulated data
Your PowerProfiler monitors even while you are connecting to power. Before you start a new monitoring session, clear all data that accumulated during setup.

1. Press **SELECT** and hold for 2 seconds.
2. Use the **VALUE UP/VALUE DOWN** buttons to select YES as your answer to the question "Clear reports" in the display window.
3. Press the **SCROLL DOWN** arrow.

To completely clear and rest your unit
You can also clear all accumulated data, return all menus to their default settings, and reset the unit to single-phase setup with the following steps:

1. Press **CANCEL PRINTER**.
2. Press **SCROLL UP** arrow.
3. Press **CLEAR** on the alpha numeric keypad.

To restart and keep data and settings
To restart your unit without clearing any settings or accumulated data:

1. Press **CANCEL PRINTER**.
2. Press **SCROLL UP** arrow.

NOTE! Changing the power type on the front panel or changing the time or date in the Setup Menu *clears all accumulated data.*

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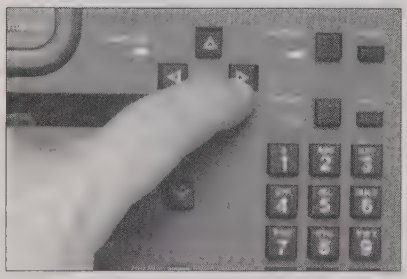
Programming Your PowerProfiler



Programming Your PowerProfiler

Your PowerProfiler was designed to be as user friendly as possible. Proper set up of your unit involves two simple steps. The first, described in this chapter, deals with the front panel operation of selecting the power type, the combination of Reports, and choosing the desired Report Intervals. This chapter will also discuss how to load the paper into your internal thermal printer whether you have the standard paper take up system or the optional disk drive.

The second step is discussed in the next chapter and involves programming with Menus. These two steps allow you to fully configure your PowerProfiler to assist you in solving your unique power monitoring needs.

Selecting Power Type

The PowerProfiler measures and monitors electrical power. Since there are various types of electrical system configurations, you need to tell the unit what type you're connected to. This is a very simple process to do, but first let's discuss what each choice is.

As stated in Chapter 3, the power system you're connected to will have either two, three, or four wires (not counting the ground conductor[s]). In most of the world, power is distributed as three phase or some variation of three phase. The most common variations are diagramed on pages 4-2 and 4-3, and are presented with their proper voltage phasor diagram.

Programming Your PowerProfiler

Selecting Power Type, continued...

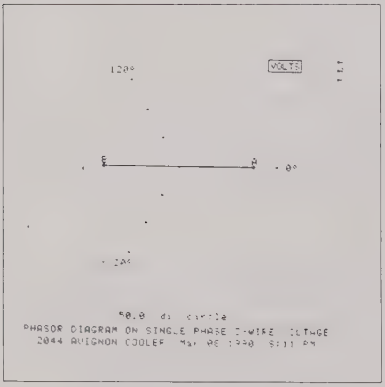
Single-Phase

This is a two wire system of either one phase and neutral or two phases.

There is not a phasor diagram for this power type.

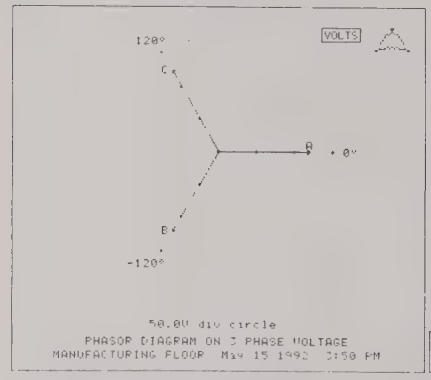
Single-Phase, 3 Wire

This is sometimes referred to as a split phase, and uses two phases and one neutral.



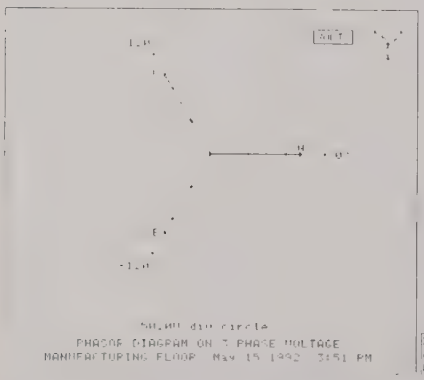
Three-Phase, 3 Wire

Usually called a Delta (Δ), this system may include variations such as an open delta, corner grounded delta, and a crazy-leg delta.



Three-Phase, 4 Wire

This is the most common facility distribution system and is called a Wye (Y).



Once you have determined the type of system you're on, refer to the Power Type section on the front panel. Use the **UP/DOWN** arrows in the Power Type section to select your power type (the LED next to your selection will flash), then press the **SELECT** button. A solid green LED now indicates the power type you have selected. Remember, you can only choose one power type. As you change to a new type, the previous selection will automatically turn off.

Programming Your PowerProfiler

Clearing Data

When beginning a new monitoring session, it is advisable to start fresh by clearing the memory.

To clear data:

- Press and hold the **SELECT** button for 2 seconds.
- Use the **VALUE UP/VALUE DOWN** buttons to select YES, then press the **SCROLL DOWN** arrow.

Changing the power type, the date, or the time will automatically clear all accumulated data.

Selecting Reports

As part of the front panel operation of the PowerProfiler, you can select certain parameters for monitoring purposes. These parameters are sectioned into five reports and listed below. These reports include ones for Power Consumption, Power Factor, Harmonics, Voltage & Current and Efficiency. They are also summarized in the Option Overview Chart of Chapter 2, and are discussed in greater detail in Chapter 6.

All of these reports gather and process data from the voltage and current connections without any additional equipment (except Efficiency which requires a second PowerProfiler). The Efficiency report is discussed in more detail below.

To select reports: (All buttons are in the Reports section of the front panel.)

- **Press the UP/DOWN buttons until the LED next to the desired report blinks.**
- **Press ON/OFF**. If the light was off and is now blinking red, pressing the **ON/OFF** button will turn it on. If the light was solid green and is now flashing green, pressing the **ON/OFF** button will turn that report off. Any combination of reports can be selected.

Measurement data is constantly being obtained for all reports for all report intervals. Turning a report on or off merely tells the unit to print the results at the end of the chosen interval(s). If you turn a report on when near the end of an interval, you will get full data for the entire interval.

Efficiency Reports

As stated earlier, obtaining efficiency reports requires a second PowerProfiler. Both

must be configured with the P-301 Demand Option Package. Efficiency measurements will automatically be made by using the data from both units. One unit should be connected to the input of the system or device on which efficiency data is desired, the other to the output. By linking these two units together via RS-232 or internal modem, accurate efficiency measurements will be made.

To set up for efficiency measurements:

1. Connect one PowerProfiler to the system input and the second unit to the system output (see "Connecting to Power", Chapter 3).
2. Link the two together via RS-232 or the optional internal modems.
3. Designate the unit on the INPUT as the Master and the OUTPUT as the SLAVE (see Chapter 5, Communications Menu).
4. Using the Communication Menu on each unit, configure them according to Table 4-1.

Table 4-1 Efficiency Configuration

RS-232		
	Master	**Slave**
Port:	RS-232	RS-232
RS232:	Type	Type
Type:	Master	Slave (Slave printer: ON or OFF)
RS232:	Configuration	Configuration
Configuration:	Baud rate	Baud rate
Baud rate:	2400	2400
Internal Modem		
	Master	**Slave**
Port:	Internal Modem	Internal Modem
Modem:	Type	Type
Type:	Master	Slave (Slave printer: ON or OFF)
Modem:	Configuration	Configuration
Baud rate:	2400	2400
Dialing:	Cabled	Cabled

Once the PowerProfilers have been properly connected to the system or device, and they have been configured according to Table 4-1, you are now ready to make the communications link.

Programming Your PowerProfiler

To establish communications link and begin efficiency measurements:

1. Press the **MENUS** button on the Master unit to access menus.
2. Press the **VALUE DOWN** button until you reach [Menu: Communication].
3. Enter/select the following information according to your communications link:

RS-232	Modem
Port: RS-232	Port: Internal Modem
RS232: Type	Modem: Type
Type: Master	Type: Master
Link RS-232 now: Yes	Link cable now: Yes

You'll notice that the Master will now control the Slave. All printouts from the Slave will also be printed at the Master. Note that the Master will not print out any of its own information. Any front panel, meter, or menu operations will be performed on the Slave unit only.

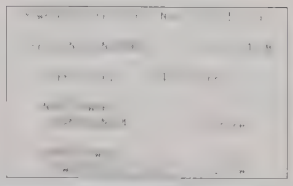
Efficiency measurements, whether reports, Summaries, or snapshots, will be determined by:

Efficiency (%) = Slave output watts / Master input watts * 100%

To disconnect from efficiency measurements:

1. Access the Communications Menu on the Master unit as outlined above.
2. Change the menu settings to the following:

RS-232	Modem
Port: RS-232	Port: Internal Modem
RS232: Go off now	
Modem: Hang up now	



This will end the communications link and restore normal operation of both Master and Slave. An

Efficiency Snapshot is shown at right, and a typical Efficiency Report is included in Chapter 6, "Using PowerProfiler Data."

Selecting Report Intervals

Monitored report data requires a specified time frame in order to be processed and printed. This is the function of Report Intervals. As with reports, you can select any combination of intervals. Choosing an interval towards the end of that interval will still provide a full interval's data.

Report intervals are hourly, daily, weekly, and monthly. Hourly reports are printed on the hour. Daily reports are printed at midnight. Weekly reports are printed at midnight on Sunday. Monthly reports are printed at midnight of the last day of the month, or midnight of the day before the "Start Day" specified in the Rate Structure Menu.

To select one or more report intervals:

1. Press the **UP/DOWN** buttons until the LED next to your selection flashes.
2. Press the **ON/OFF** button to change the flashing LED to a solid green LED.
3. Repeat for all intervals desired.

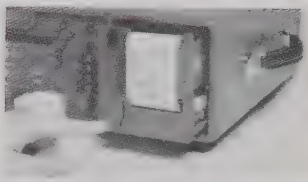
To turn off a report interval:

1. Press the **UP/DOWN** buttons until the LED next to your selection flashes.
2. Press the **ON/OFF** button to change the green LED to a flashing red LED.
3. Repeat for all intervals to be turned off.

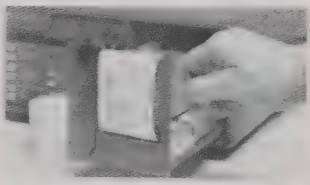
NOTE! Report intervals cannot be turned on unless the Graphics Option Package P-304 is installed.

Programming Your PowerProfiler

Loading Paper

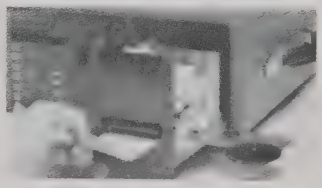


1. **Move RUN/LOAD lever to the LOAD position.**
2. **Push down the door release, and pull open the printer.** Slide the printer all the way out.



3. **Turn the handled screw counterclockwise and open the printer's right side cover.**
4. **Remove the full roll of paper from the takeup spindle.**

5. **Transfer the empty spool from the load spindle to the takeup spindle.**
6. **Put a new roll of paper on the load spindle.**



7. **Thread the paper through the printer.** Paper will exit through the slot in the door.
8. **Run paper over the top of the door, and attach to takeup spool.**

9. **Replace the right side cover, and tighten the handled screw.** Make sure you feel it snap into place.
10. **Close the printer and return the RUN/LOAD lever to the RUN position.**

Loading Paper on Units with Diskette Drive
Follow steps 1 and 2, then remove empty spool by releasing the left knob, insert a new roll of paper, and slide the paper through the slot in the door. Finish with step 10.

Using the Menus

The capability and flexibility of your PowerProfiler is determined by the options you've selected and how you've programmed those options to gather, process, and output data. Some of this measurement prowess was discussed in the previous chapter on front panel programming. The bulk of the operational selectivity relies on proper use of the menus. As you configure your unit through the menus you are telling the unit how to measure and process data to meet your unique needs. As these needs change, so can the configuration. Software and hardware options can be installed at any time to open up new measurement opportunities and more menu-driven capabilities.

Each menu is described in this chapter through the step-by-step process of a menu tree. Each step is fully defined with user information along with any default settings or other helpful information. You may want to review the Options Overview Chart in Chapter 2 with this section. Any values listed in the following menu trees represent the default values for each item.

Entering Information into Menu Selections

Data is entered into the menu selections using the **SCROLL** arrows, **VALUE UP/VALUE DOWN** buttons, and the alpha/numeric keypad.

If the menu selection offers you preset choices, use the **VALUE UP/VALUE DOWN** buttons to select your choice by positioning it in the display window. Enter your selection by pressing the **SCROLL DOWN** arrow. If the menu selection is set to cause your PowerScope to perform a function based on your response, pressing the **SCROLL DOWN** arrow will activate that function (i.e., in the Communication Menu, positioning 'Hang Up Now' in the display window then pressing the **SCROLL DOWN** arrow causes immediate termination of the connection).

Some menu selections allow you to enter text or values to meet your specific needs. Enter this data using the alpha/numeric keypad. For example, in the Setup Menu you want to enter your own site name (Bldg 1). At the selection [Site:]:

- **Press the 2ABC button three times** (your first push will bring up a 2, the second an A, and the third a B).

- Press the **SCROLL RIGHT** arrow to move your blinking cursor to the second position.

Menus

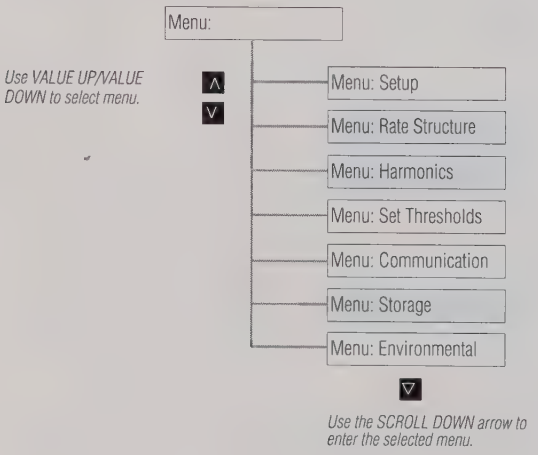
Press the 5JKL button four times to position an L.

Press the SCROLL RIGHT arrow.

Continue entering the letters and numbers for your site name using the alpha/numeric keypad and the SCROLL RIGHT arrow. Use the **CLEAR** button on the keypad to enter blank spaces, and to remove any unwanted or additional characters.

Press the SCROLL DOWN arrow. This enters the name you have selected and moves you to the next menu selection.

To Access the Menus
Press the **MENUS** button.



Legend to Menu Symbols

Menu: Rate Structure	Display window, standard menu selection.
Menu: Storage	Menu or selection available only if the corresponding Option Package is installed.

VALUE UP/VALUE DOWN buttons
Use these to select a menu or enter information.

SCROLL UP/SCROLL DOWN arrows
Use these to move up and down through the menu selections.

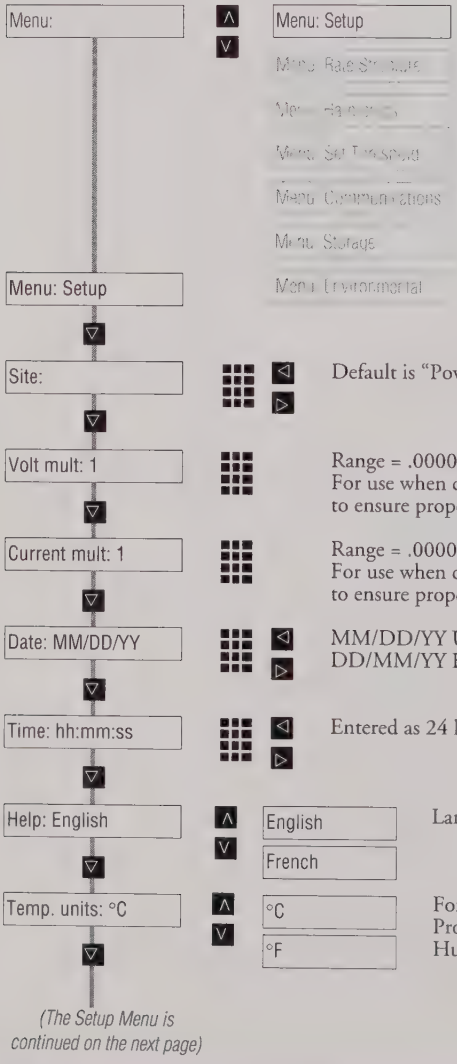
SCROLL LEFT/SCROLL RIGHT arrows
Use these to move the cursor left and right in the menu selections.

Alpha/Numeric keypad
Use this to enter letters, numbers, and blank spaces. See the example in Entering Information into Menu Selections.

Menus

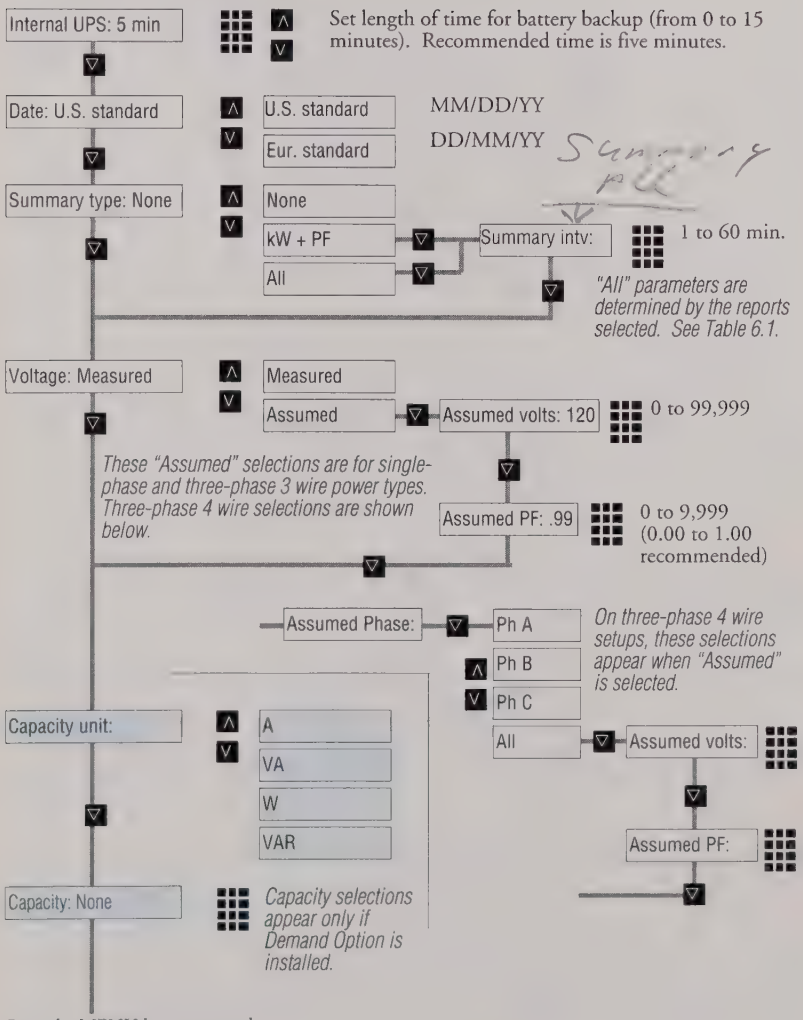
The Setup Menu

Press the MENUS button to access menu selection


Menu:
Menu: Setup
Menu: Setup
Site:
Default is "PowerProfiler Site"
Volt mult: 1
Range = .000001 to 9,999,999
For use when connected to Potential Transformers to ensure proper ratios.
Current mult: 1
Range = .000001 to 9,999,999
For use when connected to Current Transformers to ensure proper ratios.
Date: MM/DD/YY
MM/DD/YY U.S. Standard (default)
DD/MM/YY European Standard
Time: hh:mm:ss
Entered as 24 hour clock; displayed as AM or PM.
Help: English
English
French
Language for printed help messages
Temp. units: °C
°C
°F
For use with the A-002 Temperature Probe, and A-003 Temperature/ Humidity Probe

(The Setup Menu is continued on the next page)

Setup Menu, continued...

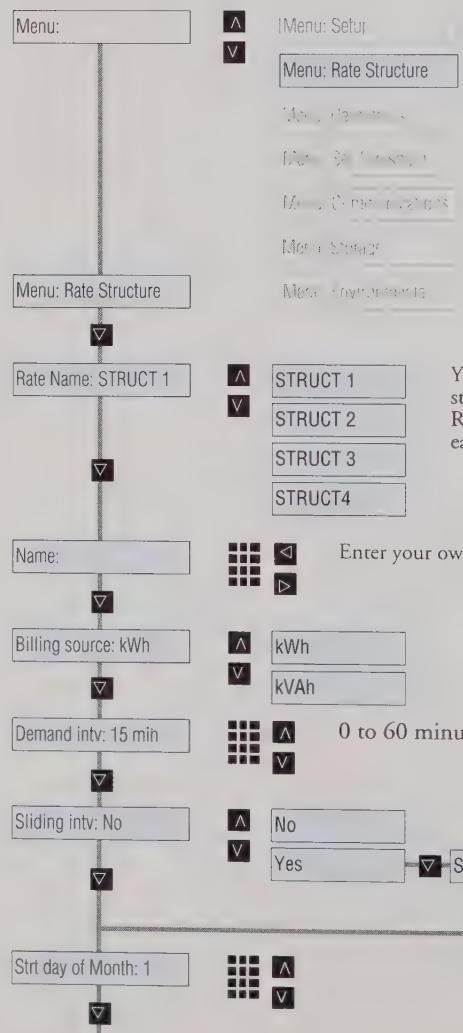


Press the MENU key to get to the top of the menus, or press the METERS key twice to get to the top of the meters.

Menus

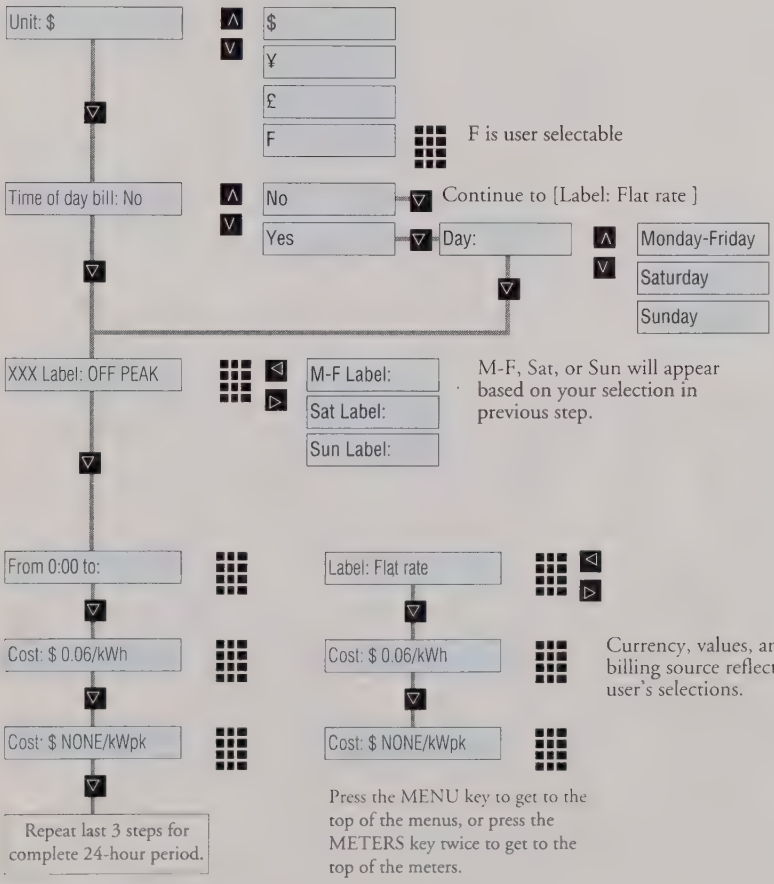
The Rate Structure Menu

This menu is available only if the Demand Option Package P-301 is installed.

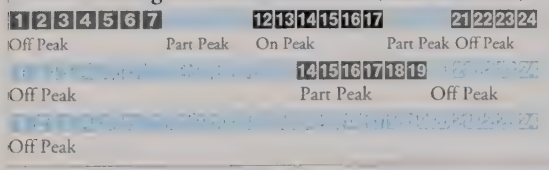


(The Rate Structure Menu is continued on the next page)

Rate Structure Menu, continued...



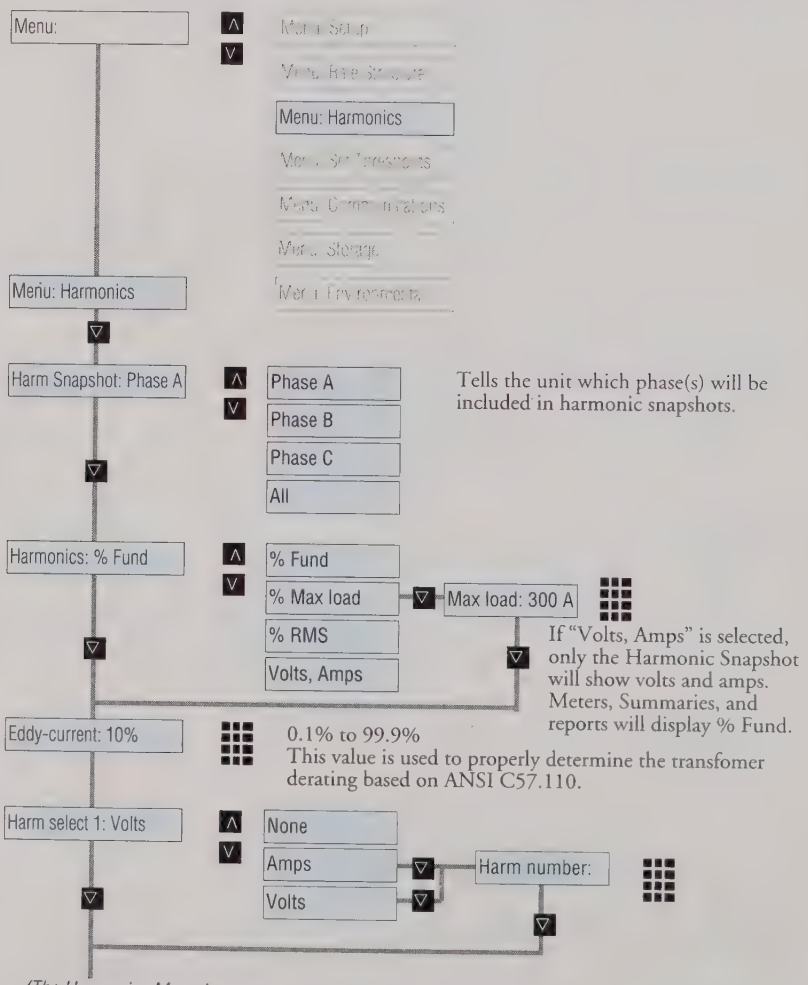
Default Settings for Rate Strucutres (scale in hours)



Menus

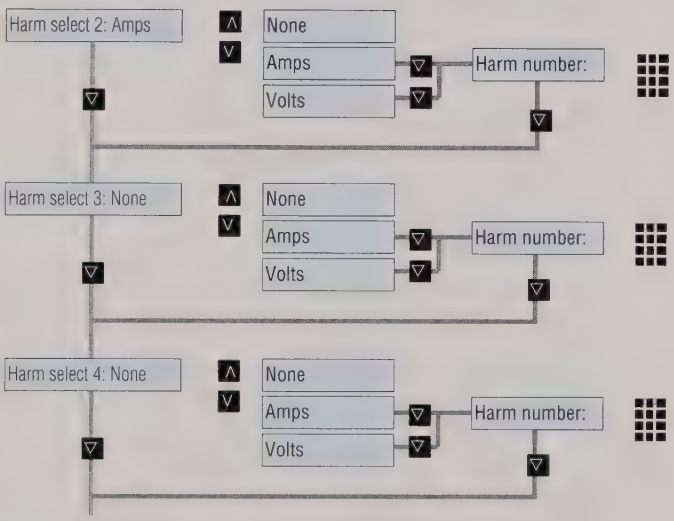
The Harmonics Menu

This menu is available only if the Harmonic Option Package P-302 is installed.



(The Harmonics Menu is continued on the next page)

Harmonics Menu, continued...

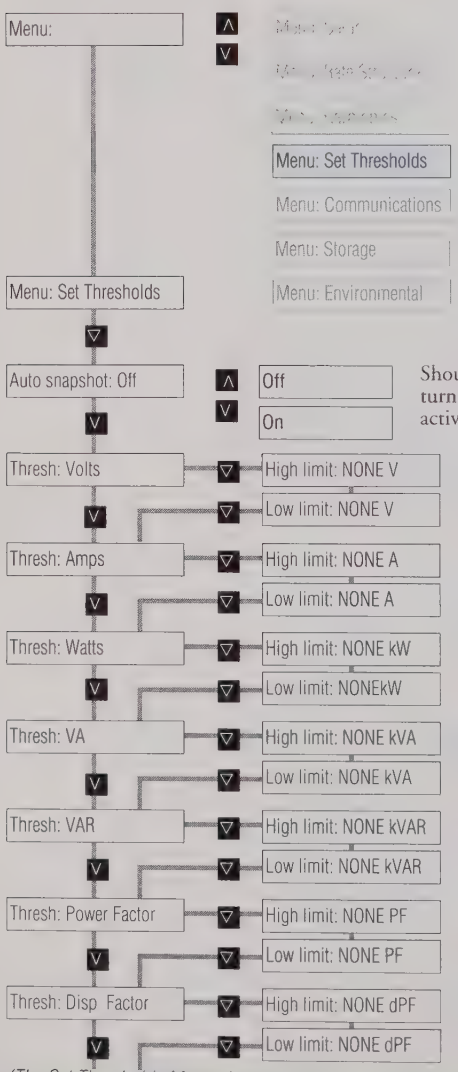


Press the MENU key to get to the top of the menus, or press the METERS key twice to get to the top of the meters.

Menus

The Set Threshold Menu

Press the MENUS button to access menu selection.



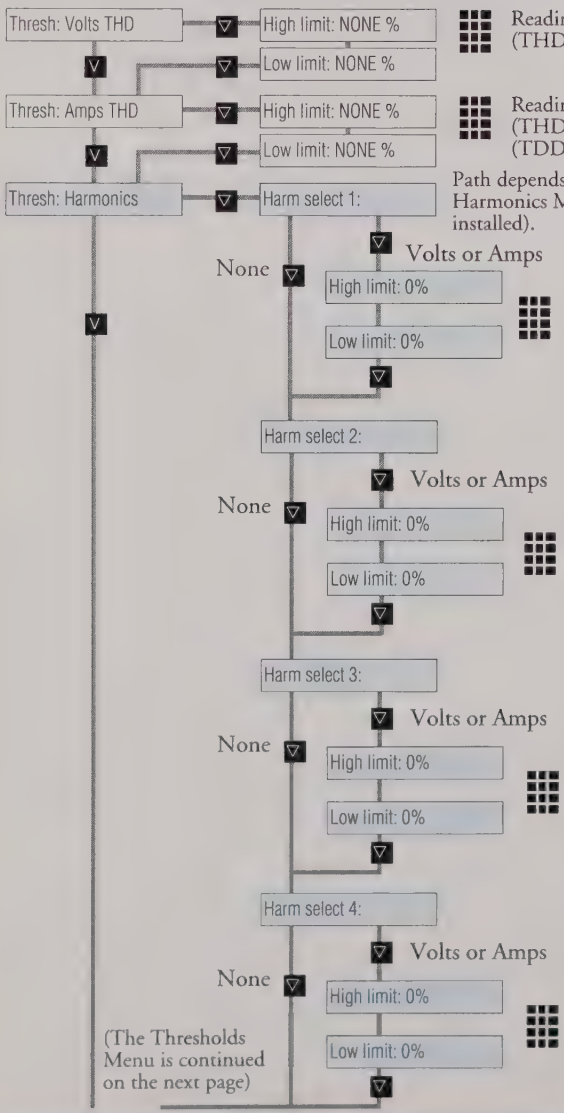
Should any of the thresholds be exceeded, turning Auto Snapshot on will printout all active snapshots.

For poly-phase power types, the voltage thresholds are compared with the total voltage.

For poly-phase power types, the current thresholds are compared with the total current, not the phase currents.

(The Set Thresholds Menus is continued on the next page)

Threshold Menu, continued...



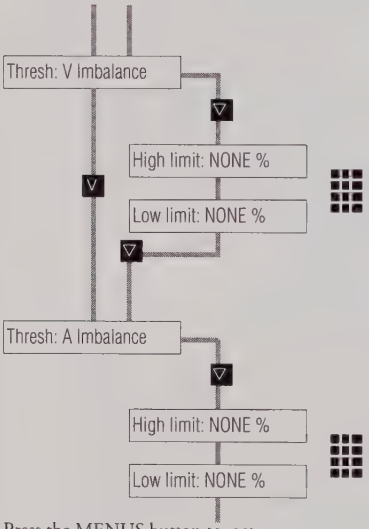
Readings can be % Fundamental (THD) or % RMS (thd).

Readings can be % Fundamental (THD), % maximum load (TDD), or % RMS (thd).

Path depends on selection made from Harmonics Menu (P-302 must be installed).

Menus

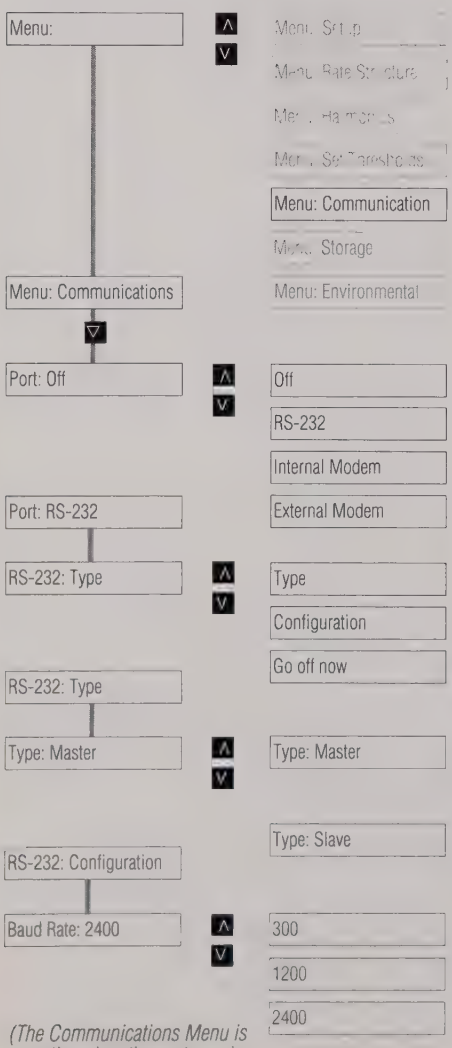
Threshold Menu, continued...



Press the MENUS button to get to the top of the menus, or press the METERS button twice to get to the top of the meters.

The Communications Menu

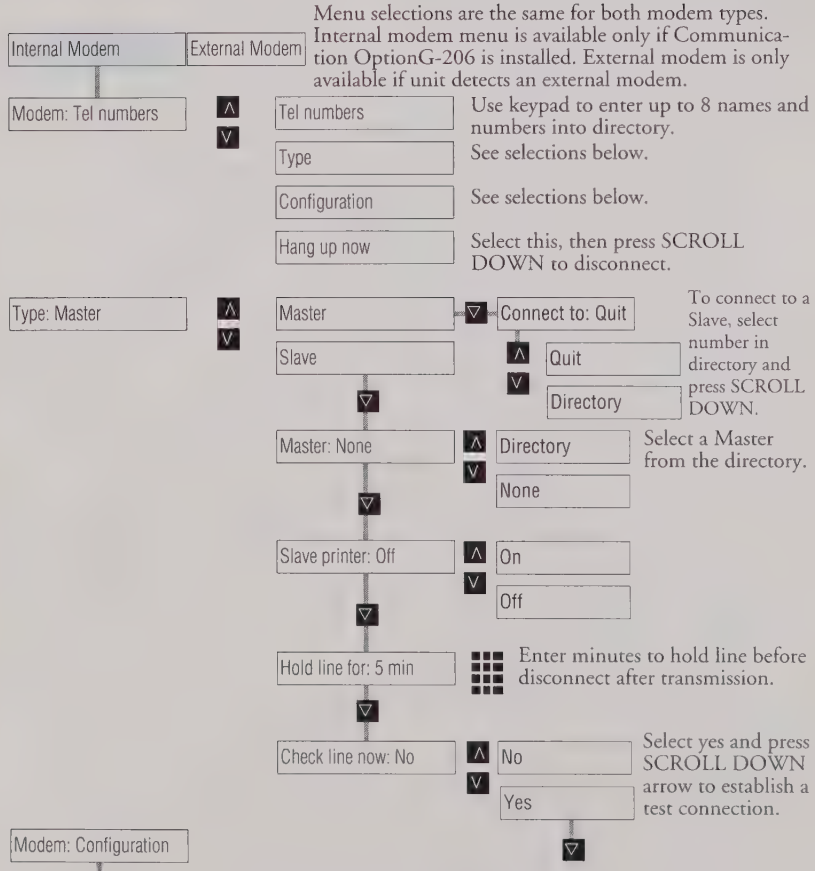
Press the MENUS button to access menu selection.



(The Communications Menu is continued on the next page)

Menus

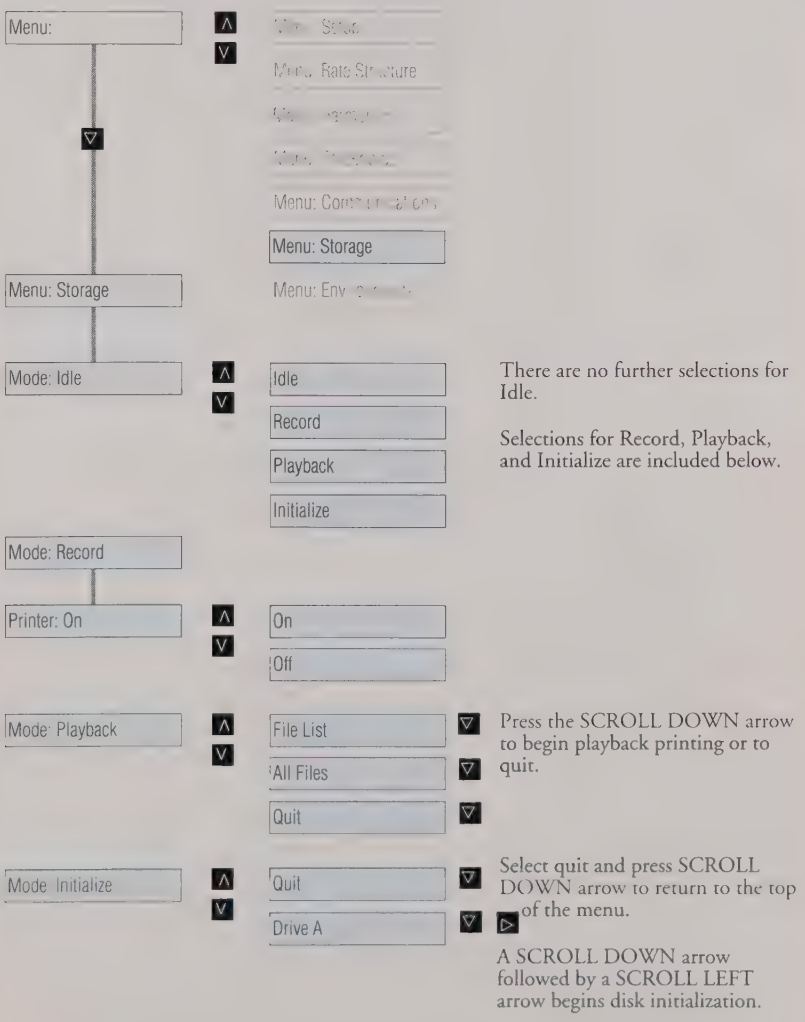
Communications Menu, continued...


Menu selections are the same for both modem types. Internal modem menu is available only if Communication OptionG-206 is installed. External modem is only available if unit detects an external modem.
Internal Modem
External Modem
Modem: Tel numbers
Tel numbers
Use keypad to enter up to 8 names and numbers into directory.
Type
See selections below.
Configuration
See selections below.
Hang up now
Select this, then press SCROLL DOWN to disconnect.
Type: Master
Master
Connect to: Quit
To connect to a Slave, select number in directory and press SCROLL DOWN.
Slave
Quit
Directory
Master: None
Directory
Select a Master from the directory.
None
Slave printer: Off
On
Off
Hold line for: 5 min
Enter minutes to hold line before disconnect after transmission.
Check line now: No
No
Select yes and press SCROLL DOWN arrow to establish a test connection.
Yes
Modem: Configuration
Baud rate: 1200
Select from 300, 1200, or 2400.
Dialing: Pulse
Select pulse, tone, or cabled. Cabled allows two units to communicate modem-to-modem without an acutal telephone network.
Answer tone: Bell
Select from Bell or CCITT answer tones.
Carrier delay: 15 sec
Use the keypad to enter the desired carrier delay (entered in seconds, 0 to 60).

Press the Help! button at any time for more information

The Storage Menu

This menu is available only if the Storage Option Package P-360 is installed.



Menus

Environmental menus
(See page 8-1 for more information.)

Using PowerProfiler Data

Your PowerProfiler is a versatile and powerful tool. Its features and capabilities allow you to gather the right data, and the right amount of data, to help you resolve your energy management concerns. As with all tools, however, the PowerProfiler is only as useful as you, the user, are knowledgeable of how to use it. This chapter explains how each of the four output data types works, what each means, and how to use them effectively. Since these four types – meters, summaries, snapshots, and reports – change with different options and power types, it is strongly suggested you review Chapter 2 and each option description.

Meters

See also Chapter 2 "Option Overview Chart", Chapter 11 "Theory of Operation", Appendix A "Meter Trees", and the glossary for more information on Meters.

Meters conveys real time data to the display window. This data is updated every sample period and is accurate for all voltage and current signals regardless of waveshape. Digital sampling also ensures that calculated data such as watts or harmonic distortion will be accurate over the wide range of non-linear signals.

To access Meters, simply press the **METERS** button on the front panel. This displays the present parameter in the LED window. Meters are, in effect, a constantly updated spreadsheet with rows and columns. Each row represents a different parameter family and each column has the values of specific parameter members for the different power types. For example, row 1 displays voltages. For three-phase, 4 wire power types, cell 1-1 (row 1, column 1) shows the average voltage while cell 1-2, cell 1-3, and cell 1-4 show the phase-to-neutral voltages. Row 2 displays current with each column similar to the voltage parameters. This spreadsheet style is summarized in Appendix A for each power type and each software option. If you see a message within "< >" symbols, it is a placeholder for a cell not being used.

By using the **SCROLL** arrows, you can easily access all metered data. If, for a given moment in time, you want all values of metered data, simply press the **PRINT** button beside the **METER** button.

```
POWERPROFILER SITE   Dec 13 1991 (Fri)
METERS                        2:01:37 PM

Voltage:                    283.0 Vrms
    Phase A-N:              282.8 Vrms
    Phase B-N:              281.8 Vrms
    Phase C-N:              284.2 Vrms
    Neut-Gnd:                 0.2 Vrms
    Imbalance:                0.4%

Current:                     95.9 A rms
    Phase A:                31.2 A rms
    Phase B:                31.5 A rms
    Phase C:                33.2 A rms
    Neutral:                 0.6 A rms
    Imbalance:               3.8%

Power:                      19.34 kW
    Phase A-N:               6.154 kW
```

Figure 6-1: Sample Meter Printout

Using PowerProfiler Data

Summaries

See also Chapter "Option Overview Chart", Chapter 5 "Setup Menu" and "Storage Menu", Chapter 7 "Export Software", and the glossary for more information on Summaries.

Your PowerProfiler acquires, processes, and outputs data in a variety of forms. Two of these forms – snapshots and reports – require the Graphic Option Package P-304 to function. Thus, the base unit does not support these two output types. If the only other choice was using Meters, the PowerProfiler would simply be a sophisticated power meter, not a functional monitor. Because of this, Summary output is available. As stated in Chapter 2, Summaries will provide printed information on watts and PF only, or on all measured parameters based on the front panel selection of reports. This data is gathered at user defined intervals of 1 to 60 minutes, and is averaged over the entire interval, not simply sampled once during the interval. Minimum and maximum values are also given for the interval. Since Summaries are part of the base unit, they are available regardless of the options you have.

To access Summaries:

1. **Press the MENUS button.** The display will read [Menus: Setup].
2. **Press SCROLL DOWN arrow until the display reads [Summary type:].**
3. **Use the VALUE UP/VALUE DOWN buttons to position your selection in the display.** Select from "None", "kW+PF" or "All".

   If you select "All", refer to Table 6-1 to determine what reports need to be turned on in order to obtain data on the desired parameters. Remember, different power types utilize different parameters.
4. **Press the SCROLL DOWN arrow to enter your selection**. The display now reads [Summary intv:].
5. **Use the alpha/numeric keypad to enter your desired summary interval** (from 1 to 60 minutes).
6. **Press the SCROLL DOWN arrow to enter your selection.** Press **MENUS** to return to the top of the menu, or **METERS** to go to meters.

Table 6.1: Reports Required for Summary Information

Reports	Single-Phase Power Type	Polyphase Power Type
None	• Avg watts and PF *	• Avg total watts and PF *
Power Consumption	• Accum. phase Wh, VARh, Qh • Min, max, avg W, VA, VAR	• Accum. total Wh, VARh, Qh • Min, max, avg phase & total W, VA, VAR (Delta-total only)
With P-301	• Min, max, avg capacity, cost/hr	• Min, max, avg capacity, cost/hr
Power Factor	• Min, max, avg PF & dPF	• Min, max, avg phase & total PF and dPF
Harmonics	• Min, max, avg voltage THD • Min, max, avg current THD	• Min, max, avg phase & total V THD • Min, max, avg phase & total I THD • Min, max, avg V & I sequences
With P-302	• Min, max, avg trans. derating • Min, max, avg I*T product • Min, max, avg ind. harmonics	• Min, max, avg trans. derating • Min, max, avg phase & total I*T Product • Min, max, avg ind. harmonics
With P-303		• Min, max, avg neutral current THD
Voltage & Current	• Min, max, avg V, I, & freq. • Min, max, avg current phase shift	• Min, max, avg phase & total V, I, imbalances, & frequency • Min, max, avg current phase shift
With P-303	• Min,max, avg N-G voltage	• Min, max, avg N-G voltage & neutral current
Efficiency Requires two PowerProfilers, each with P-301	• Min, max, avg efficiency	• Min, max, avg total efficiency

* Added to every report

If the time at which you began collecting data for Summaries is not exactly when you want, you can reset the start time of the interval at any time. As an example, the start time for your 15 minute interval is 9:08 a.m., but you would prefer it at the quarter hour (:15, :30, :45, :00). At 9:15, press **CANCEL PRINTER** and then the **SCROLL UP** arrow. The PowerProfiler will do a soft reset (memory and the configuration data remain unchanged) and the interval will now start at 9:15 and continue every 15 minutes as desired.

As the data is gathered, it can be printed on the internal printer, stored on the optional internal diskette drive, or sent to a PC running PowerTalk software. The accumulated data can be converted to ASCII format (if stored on a disk or to a PC) so that it can be imported into most standard spreadsheet programs such as Microsoft Excel or Lotus 1-2-3. Once loaded into a spreadsheet, your ability to make calculations or graphs is limited only by the capability of the spreadsheet.

Using PowerProfiler Data

Some examples of what you can do are listed below.

Calculations

- Demand over any interval
- Cost according to any rate structure
- kWh, kVAh over longer intervals
- Impact of energy management techniques, such as PF correction

Graphs

- Volts, amps, power, etc.
- Comparison graphs relating multiple parameters over the same time:
  - capacity vs. transformer derating
  - power vs. power factor

Snapshots

See also Chapter 2 "Option Overview Chart" for more information on snapshots.

Normally, an energy demand, or harmonics analyzer is considered to be acquiring and processing data over time. This is an appropriate position to take, but not at the expense of implying that instantaneous measurements are not also valid for these products. The instantaneous measurements made by the PowerProfiler are either meters (discussed earlier) or snapshots. Snapshots are real time measurements made on request, providing a brief look at the power system. They contain both graphics and text, and are easily accessed by the front panel. Remember, that you need the Graphics Option Package P-304 installed in your unit to get snapshots.

Snapshots are related to reports in that for each report type there is a corresponding snapshot. Accessing a snapshot, then, means first selecting the report the snapshot is associated with.

To print a Snapshot:

1. **Press the UP/DOWN arrows in the Report section.** When the LED next to the desired report is flashing, you have selected that report.

2. **Press PRINT SNAPSHOT.** The information will now be output to the printer, disk drive, and/or the communications port (based on your menu configuration).

If no LEDs are flashing when you press **PRINT SNAPSHOT**, snapshots for all reports currently turned on will be generated.

Using PowerProfiler Data

To understand more of what Snapshots are and how to use them, samples of each are presented here.

Figure 6.2: Power Consumption Snapshot

```
POWER CONSUMPTION SNAPSHOT  4:32:52 PM

  INSTANTANEOUS POWER    16.38 kW
  ------------------------------

    Phase A-N:          5.035 kW
    Phase B-N:          5.743 kW
    Phase C-N:          5.598 kW


---------------------------------------
POWERPROFILER SITE   Dec 13 1991 (Fri)

PHASE A POWER SNAPSHOT       4:32:54 PM

  INSTANTANEOUS POWER:       5.035 kW
```

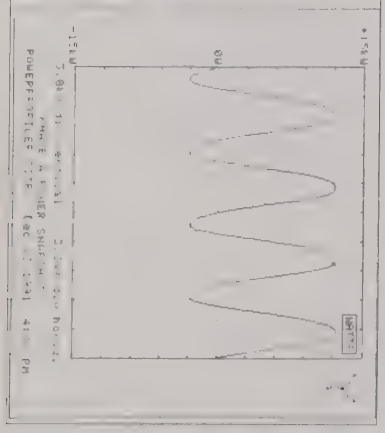


Figure 6.3: Power Factor Snapshot

```
POWERPROFILER SITE   Dec 13 1991 (Fri)

POWER FACTOR SNAPSHOT        4:33:09 PM

  INSTANTANEOUS POWER    16.38 kW
  ------------------------------

    Phase A-N:          5.035 kW
    Phase B-N:          5.743 kW
    Phase C-N:          5.598 kW

  VOLT-AMPS              24.69 kVA
  ------------------------------

    Phase A-N:          7.831 kVA
    Phase B-N:          8.137 kVA
    Phase C-N:          8.721 kVA

  VA REACTIVE            18.44 kVAR
  ------------------------------

    Phase A-N:          6.029 kVAR
    Phase B-N:          5.766 kVAR
    Phase C-N:          6.645 kVAR

  TRUE POWER FACTOR        0.66 PF
  ------------------------------

    Phase A-N:          0.64 PF
    Phase B-N:          0.71 PF
    Phase C-N:          0.64 PF

  DISPLACEMENT FACTOR    0.66 dPF
  ------------------------------

    Phase A-N:          0.64 dPF
    Phase B-N:          0.70 dPF
    Phase C-N:          0.64 dPF
```

Not shown in Figure 6.2:

- Phase B Power Snapshot
- Phase C Power Snapshot
- Total Power Snapshot

Using PowerProfiler Data

Figure 6.4: Harmonics Snapshot

```
HARMONICS SNAPSHOT              4:33:18 PM

 Fundamental freq:    60.0 Hz

  VOLTAGE THD              1.9% THD avg
  ------------------------------
    Phase A-N Volts:   1.8% THD
    Phase B-N Volts:   1.9% THD
    Phase C-N Volts:   1.9% THD

  CURRENT THD              4.6% THD avg
  ------------------------------
    Phase A Current:   4.7% THD
    Phase B Current:   4.9% THD
    Phase C Current:   4.2% THD
    Neutral Current:  65.8% THD


-------------------------------------
POWERPROFILER SITE   Dec 13 1991 (Fri)

PHASE A VOLTAGE SPECTRUM    4:33:22 PM

 Fundamental volts: 284.3 Vrms

 Fundamental freq:   60.0 Hz

                 SINE                    SINE
HARM   PCT     PHASE     HARM   PCT     PHASE
---- ------   -------   ---- ------   -------
FUND 100.0%     0°       2nd
 3rd   0.6%   146°       4th
 5th   1.7%   147°       6th
 7th   0.3%    82°       8th
 9th   0.1%   -60°      10th
11th   0.1%    69°      12th
```

Not shown in Figure 6.4:

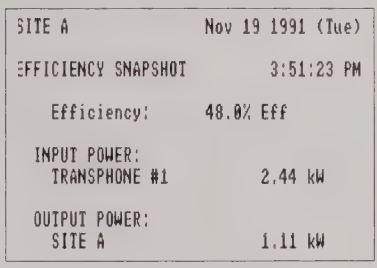
- Phase A Current Spectrum & Graph
- Phase A Power Spectrum
- Neutral Current Spectrum & Graph

If requested in Harmonics menu, similar printouts are available for Phase B and Phase C.

Figure 6.5: Voltage & Current Snapshot

```
POWERPROFILER SITE   Dec 06 1991 (Fri)

VOLTAGE & CURRENT SNAPSHOT  5:23:24 PM

  VOLTAGE              283.6 Vrms
  ------------------------------
    Phase A-N: 283.7 Vrms,    0°(ref)
    Phase B-N: 281.7 Vrms, -119°
    Phase C-N: 285.5 Vrms,  121°
    Neut-Gnd:    0.0 Vrms,    1°
    Imbalance:   0.7%

  CURRENT               63.1 A rms
  ------------------------------
    Phase A:    20.6 A rms, -54°
    Phase B:    19.9 A rms,-166°
    Phase C:    22.6 A rms,  71°
    Neutral:     0.5 A rms,-168°
    Imbalance:   7.4%


-------------------------------------
POWERPROFILER SITE   Dec 06 1991 (Fri)

VOLTAGE PHASOR DIAGRAM      5:23:26 PM

   Phase A-N: 283.6 Vfund,    0°(ref)
   Phase B-N: 281.6 Vfund, -119°
   Phase C-N: 285.4 Vfund,  121°
   Imbalance:   0.7%
```

Figure 6-6: Efficiency Snapshot



Not shown in Figure 6.5:

- Current Phasor Diagram
- Phase A V and I waveshapes
- Phase B V and I waveshapes
- Phase C V and I waveshapes
- Neutral $V_{N\text{-}G}$ and I_N waveshapes

Using PowerProfiler Data

Reports
See also Chapter 2 "Option Overview Chart", and the glossary for more information on reports.

Reports represent the bulk of your PowerProfiler's usefulness. Of the four output types, only Summaries and Reports provide long term monitoring capability and trend analysis. While the processing power behind Summaries lies in your PC, the PowerProfiler itself processes all the information needed for generating a report. No external PC or storage device is needed. Reports are made up of graphical and textual information gathered over an interval of time and presented in a comparative and comprehensive manner for analysis.

Proper utilization of Reports requires two steps. First, the desired report(s) must be selected, and second, the desired report interval(s) must be chosen.

Reports which are already turned on are indicated by a solid green LED. If the LED is off, then the report is not turned on.

To turn a report on:

1. **Press the UP/DOWN buttons in the Reports section until the LED next to the desired report flashes.** If the report was off, the LED will flash red.

2. **Press the ON/OFF button.** The LED will now flash green. In a moment, it will go to a solid green.

To turn a report off:

1. **Press the UP/DOWN buttons in the Reports section until the LED next to the desired report flashes.** If the report was on, the solid green LED will now flash green.

2. **Press the ON/OFF button.** The LED will now flash red. In a moment, the LED will turn off.

The Report Interval tells your unit how long to gather data before processing and outputting it. Each of the four intervals has its own memory, so you can select any combination of intervals to meet your needs. Note that these intervals are for Reports only and do not impact Summary operation.

To select a report interval:

1. **Press the UP/DOWN buttons in the Report Interval section until the LED next to the desired interval flashes.** If the interval was off, the LED will flash red.

2. **Press the ON/OFF button.** The LED will now flash green. In a moment, it will go to a solid green.

To turn a report interval off:

1. **Press the UP/DOWN buttons in the Report Interval section until the LED next to the desired interval flashes.** If the interval was on, the solid green LED will now flash green.

2. **Press the ON/OFF button.** The LED will now flash red. In a moment, the LED will turn off.

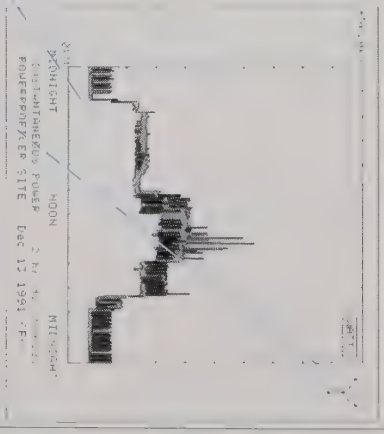
Note also in the Report Interval section the **PRINT REPORTS** button. When pressed, a report will be output for each report turned on, and for every interval turned on. These reports will be from the end of the last interval to the present. Thus, each will be a partial report containing data up to the time of request.

On the following pages, each report type is shown with explanations of the various components. Daily interval graphs are used here for demonstration.

Using PowerProfiler Data

Power Consumption Report
Instantaneous Power Report shown. This format is the same for Instantaneous Volt-Amps Report.

```
POWERPROFILER SITE   Dec 14 1991 (Sat)

POWER CONSUMPTION REPORT

   FROM: MIDNIGHT Dec 12 1991 (Thu)
   To:   MIDNIGHT Dec 13 1991 (Fri)

-------------------------------------
POWERPROFILER SITE   Dec 14 1991 (Sat)

INSTANTANEOUS POWER          12:00:02 AM

   FROM: MIDNIGHT Dec 12 1991 (Thu)
   To:   MIDNIGHT Dec 13 1991 (Fri)

Total:
          MAX:     31.9 kW,  2:15 PM
          MIN:      3.3 kW, 10:02 PM

Phase A-N:
          MAX:     10.2 kW,  2:16 PM
          MIN:      0.8 kW, 10:35 PM
Phase B-N:
          MAX:     10.0 kW,  2:15 PM
          MIN:      1.3 kW,  8:51 PM
Phase C-N:
          MAX:     11.8 kW,  2:15 PM
          MIN:      1.2 kW,  1:46 AM
```



Site name and report date (name entered in Setup Menu)

Interval of time this report covers

Date and time report was printed

Minimum and maximum values recorded in this report interval

Graphical summary report for this report interval

Indicates unit was setup for three-phase 4 wire

Graphical reports added to the Power Consumption Report by Demand Option Package P-301: Billing Demand, Load Duration, and Cash Flow.

Power Factor Report
Volt-Amps Reactive Report shown. This format is the same for Displacement Power Factor (dPF), and True Power Factor (PF) Reports.

Site name and report date (name entered in Setup Menu)

Interval of time this report covers

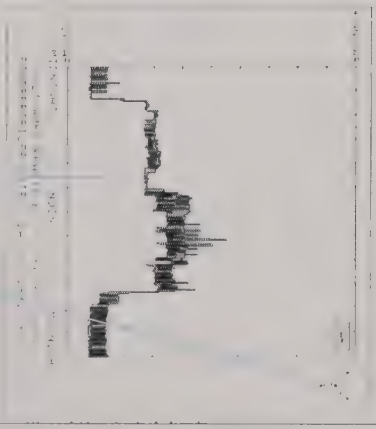
Minimum and maximum values recorded during this report interval

Minimum and maximum values recorded for individual phases during this report interval

Graphical summary report for this report interval

Indicates unit was setup for three-phase 4 wire

```
POWERPROFILER SITE   Dec 14 1991 (Sat)

VOLT-AMPS REACTIVE          12:01:25 AM

   FROM: MIDNIGHT Dec 12 1991 (Thu)
   To:   MIDNIGHT Dec 13 1991 (Fri)

Total:
          MAX:      28.0 kVAR,  2:15 PM
          MIN:       3.7 kVAR, 12:41 AM

Phase A-N:
          MAX:      10.2 kVAR,  2:15 PM
          MIN:       1.2 kVAR,  1:52 AM
Phase B-N:
          MAX:       8.3 kVAR,  2:16 PM
          MIN:       1.0 kVAR,  9:00 PM
Phase C-N:
          MAX:       9.5 kVAR,  2:16 PM
          MIN:       1.5 kVAR,  1:46 AM
```



Using PowerProfiler Data

Harmonics Report
Voltage THD shown. Format is the same for Current THD.

Site name and report date (name entered in Setup Menu)

Interval of time this report covers

Date and time report was printed

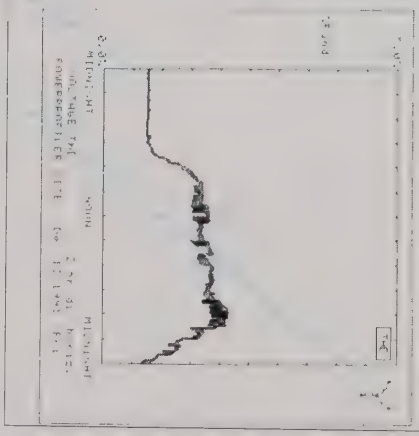
Minimum and maximum THD values recorded during this report interval (average of all phases)

Minimum and maximum values recorded during this report interval for individual phases

Graphical summary of this report for this report interval

Indicates unit was setup for three-phase 4 wire

```
POWERPROFILER SITE   Dec 14 1991 (Sat)

HARMONICS REPORT

   FROM: MIDNIGHT Dec 12 1991 (Thu)
   To:   MIDNIGHT Dec 13 1991 (Fri)


-------------------------------------
POWERPROFILER SITE   Dec 14 1991 (Sat)

VOLTAGE THD                  12:02:17 AM

   FROM: MIDNIGHT Dec 12 1991 (Thu)
   To:   MIDNIGHT Dec 13 1991 (Fri)

Average:
          MAX:      2.2% THD,  7:41 PM
          MIN:      0.7% THD, 11:49 PM

Phase A-N:
          MAX:      2.1% THD,  7:45 PM
          MIN:      0.7% THD, 11:49 PM
Phase B-N:
          MAX:      2.2% THD,  7:59 PM
          MIN:      0.6% THD,  5:55 AM
Phase C-N:
          MAX:      2.3% THD,  7:27 PM
          MIN:      0.7% THD, 11:48 PM
```



Graphical reports added to the Harmonics Report by Harmonics Option Package P-302:
Individual harmonics (V&I), and neutral current THD (with Neutral Option P-303)

Voltage & Current Report
Voltage shown. Format is the same for Current.

Site name and report date (name entered in Setup Menu)

Interval of time this report covers

Date and time report was printed

Minimum and maximum average values recorded of all phases during this report interval (total for current)

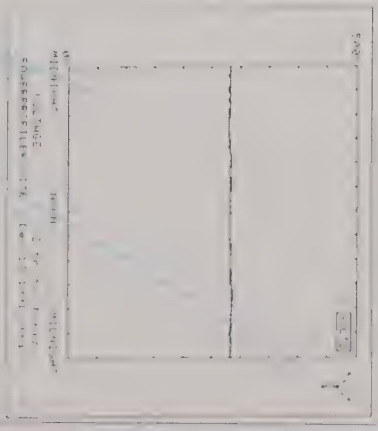
Minimum and maximum values of imbalance recorded during this report interval

Minimum and maximum values recorded during this report interval for individual phases

Graphical summary of this report for this report interval

Indicates unit was setup for three-phase 4 wire

```
POWERPROFILER SITE   Dec 14 1991 (Sat)

VOLTAGE & CURRENT REPORT

   FROM: MIDNIGHT Dec 12 1991 (Thu)
   To:   MIDNIGHT Dec 13 1991 (Fri)


-------------------------------------
POWERPROFILER SITE   Dec 14 1991 (Sat)

VOLTAGE                        12:03:48 AM

   FROM: MIDNIGHT Dec 12 1991 (Thu)
   To:   MIDNIGHT Dec 13 1991 (Fri)

Average:
          MAX:    287.7 V,   6:43 PM
          MIN:    279.4 V,   5:16 AM

VOLTAGE IMBALANCE:
          MAX:      0.8%,  5:28 PM
          MIN:      0.3%,  4:34 AM

Phase A-N:
          MAX:    287.9 V,   7:05 PM
          MIN:    279.2 V,   5:16 AM
Phase B-N:
          MAX:    285.9 V,   7:04 PM
          MIN:    278.3 V,   5:02 AM
Phase C-N:
          MAX:    289.6 V,   6:37 PM
          MIN:    280.5 V,   5:16 AM
```



Using PowerProfiler Data

Efficiency Report

Site name and report date

Date and time report was printed

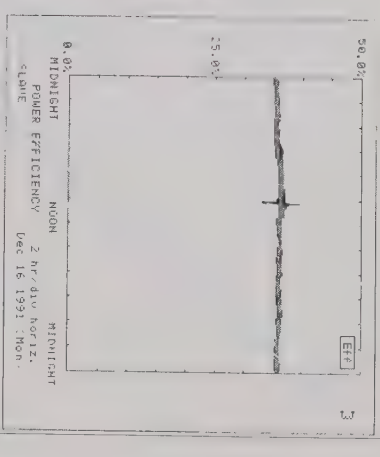
Interval of time this report covers

Maximum and minimum values of efficiency recorded during this report interval

Graphical summary of this report for this report interval

Indicates unit was setup for single-phase

```
SLAVE                          Dec 16 1991 (Mon)

EFFICIENCY REPORT

   FROM: MIDNIGHT Dec 15 1991 (Sun)
   To:   MIDNIGHT Dec 16 1991 (Mon)


---------------------------------------
SLAVE                          Dec 16 1991 (Mon)

POWER EFFICIENCY                    11:58:50 AM

   FROM: MIDNIGHT Dec 15 1991 (Sun)
   To:   MIDNIGHT Dec 16 1991 (Mon)

Total:
              MAX:     38.6% Eff, 10:22 AM
              MIN:     32.8% Eff, 10:20 AM

   INPUT POWER:   SITE MASTER
   OUTPUT POWER:  SLAVE
```



PowerProfiler to PowerProfiler, or PowerProfiler to PC

Your PowerProfiler's capabilities go beyond what has been discussed so far. Your unit can also communicate remotely with other PowerProfilers or with DOS compatible 286/386 computers. Networks of multiple units can be created to allow monitoring at many different locations simultaneously. This ability comes from the unit's remote communications features and the use of BMI's PowerTalk software.

RS-232

Although this configuration is not the most common, it is easily done. If connections are made via RS-232, only two units can be used (see Figure 7.1).

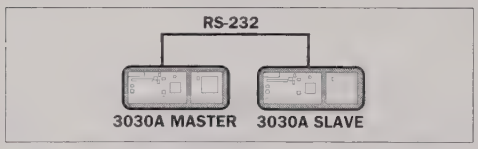


Figure 7.1: Master/Slave Configuration Via RS-232

In all forms of digital communications, something must control the handshake. Therefore, one unit must be designated the Master and the other the Slave. The Slave unit will send its information to the Master. In essence, the Master in the RS-232 configuration is a remote printer. Use the following parameters to setup your Master and Slave units (in Communications Menu):

	Master	Slave
Port:	RS-232	RS-232
Type:	Master	Slave – slave printer on or off
Configuration:	2400	2400

Networking

After the Slave is connected to power and programmed as above, go to the Master and in the Communication Menu select:

Menu:	Communication
Port:	RS-232
RS232:	Type
Type:	Master
Link RS-232 now:	Yes, and immediately press **SCROLL DOWN** arrow to establish connection

The Master now has full control over the Slave, and all printouts will be sent to the Master. Disconnect at anytime by selecting [RS-232: Go Off Now] in the Master's Communication Menu.

Modem

If you need to have one or more Slaves talk to a Master PowerProfiler via modem, similar setup steps are required with one important difference. When using modems, your communication link does not have to be continuous. PowerProfilers are designed such that if a Slave unit wants to send out data over a modem, it can call the Master itself. To do this, the Slave must know the telephone number of the Master, and the Master needs the numbers of the Slaves (see Figure 7-2).

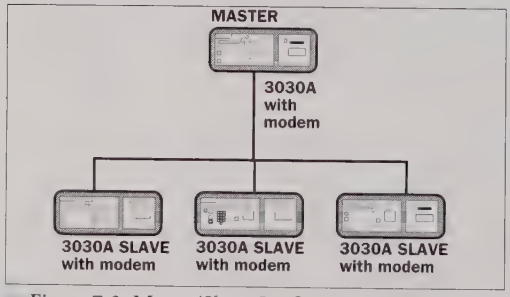


Figure 7-2: Master/Slave Configuration without a PC

To set up this type of modem network, connect each Slave unit and then program the units as follows:

	Master	Slaves
Port:	Int/ext modem	Int/ext modem
Modem:	Tel numbers – put in each Slave #	Tel numbers – put in Master #
Modem:	Type	Type
Type:	Master – Connect to: dir. of Slaves (if Master is initiating call)	Slave – Master: dir of Masters – Slave printer: your choice – Hold line for: your choice

Program the remainder of the Communication Menu according to your particular needs. Slave units will now call the Master when they have a printout. Should the Master be busy, the Slave will wait 30 seconds and retry. It will do this 3 times, and if there is still no answer from the Master, it will print to paper (and/or disk) and continue on.

PC to PowerProfiler(s)

The most common remote link is between one or more Slaves and a PC running PowerTalk software. This link can be RS-232 (only one Slave) or via modem. The programming of each Slave unit is the same as described earlier, and the programming of the PC is detailed in the PowerTalk User's Guide. The PC is the Master, and all data can be stored directly onto disk (see Figure 7.3).

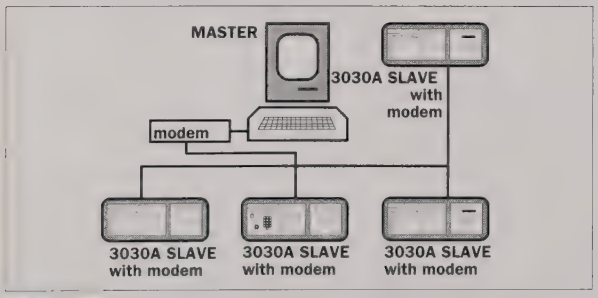


Figure 7-3: Connecting a PC to PowerProfilers Using Modems

A single PC can be dedicated to one Slave unit via RS-232. This is better than unit to unit, but requires full time use of the PC. When using modems, having the Slaves call the Master can be tricky since the Master could be busy talking to one Slave while another is trying to call. Because of this, we have found the best form of networking with multiple PowerProfilers is to have each one configured with a

diskette drive. First, store all data to the diskette drives. Then, have the Master call each Slave to collect the data. The Slave will dump all stored data, and can be reinitialized to store a full disk worth of data again. In this fashion, you seldom face the concern of not transmitting data due to a link traffic jam.

Summaries and Export

One of the most useful features of the PowerProfiler is Summaries. In a remote link or networking configuration, Summaries will play an important role in keeping you informed and supplying you with data.

A base unit – one with no option packages– still has Summaries and RS-232 capability. By using PowerTalk, the summary printouts can be stored directly to a PC. If a unit is configured with the optional diskette drive it can store the summaries directly to disk.

Once in the PC or on a floppy, the data can be viewed with PowerTalk, or exported to a format that can be read and manipulated by most popular spreadsheet applications. BMI's Export software (a part of PowerTalk) allows PowerTalk data collected from BMI units to be output in a variety of formats. The PowerTalk User's Guide contains descriptions and instructions on the use of Export.

NOTE! Export presently converts only the average watts and power factor measurements. Contact BMI for availability of the enhanced Export version capable of converting all parameters.

SmartProbes, Environmental Probes

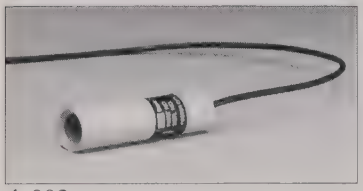
Environmental Probes
The PowerProfiler recognizes all BMI environmental probes. Graphs and reports are automatically added to the full list of standard reports.

To set up probes:

1. **Plug your probe into one of the environmental channels on the back of the unit.**

2. **Press CANCEL PRINTER immediately followed by the SCROLL UP arrow.** The PowerProfiler's menus and printouts show any probes which you have attached. You can attach up to four probes at any time.

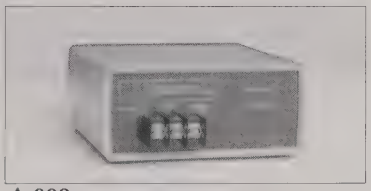
3. **Press the MENUS button, and then the VALUE UP/VALUE DOWN buttons to access the Environmental Menu.** The complete menu is shown in Chapter 5.



A-002
Temperature Probe
Measures temperature and rate-of-change in temperature.

A-003
Temperature/Humidity Probe
Measures temperature, humidity, and their rates-of-change.

A-012
RFI Probe Interface
Graphs radio frequency interference using an Instrument for Industry model EFS-3 probe (not included).



A-009
Contact Closure Probe
Provides a 2 second contact closure if any thresholds are exceeded (see Thresholds Menu in Chapter 5).

A-111
AC/DC/Impulse Probe
Records power sags, surges, and impulses.

SmartProbes, Environmental Probes

SmartProbes

See Chapter 3 for more information on the number of SmartProbes required for your power type, and for connection instructions.

A-115

60 Amp AC Clamp-on SmartProbe

(left in photo)

Use this clamp-on probe to take quick measurements of CTs and for monitoring individual loads up to 60 amps.

Range:	1-60 A
Usable Bandwidth:	50 Hz – 1 kHz
Isolation:	3,000 V
Max Cable Diameter:	0.47 in (12 mm)

A-116

600 Amp AC Clamp-on SmartProbe

(second from left in photo)

This is the general purpose current probe for most applications.

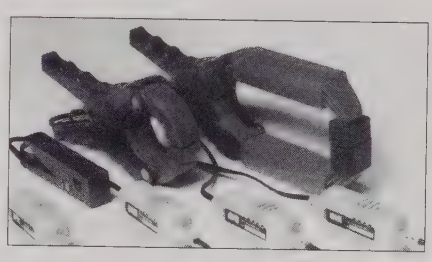
Working Voltage:	600 V
Range:	1-600 A
Usable Bandwidth:	50 Hz – 3 kHz
Isolation:	2,000 V
Max Cable Diameter:	2 in (54 mm)

A-118

KYZ Probe

(not shown)

Interfaces with the PowerProfiler to a standard KYZ or other dry-contact output devices such as a watthour meter. Measures Wh, Varh, and Qh. Also measures Vah with Demand Option P-301.



A-120

3,000 Amp AC Clamp-on SmartProbe

(far right in photo)

Use this large probe for measuring high-current bus bars.

Range:	10-3,000 A
Usable Bandwidth:	30 Hz – 3 kHz
Isolation:	4,000 V
Jaw Window:	2.56 in (65 mm) cable
	1.97 x 5.31 in (50 x 135 mm) bar
	2.56 x 3.94 in (65 x 100 mm) bar

A-121

20 Amp AC CTIP

(not shown)

This probe includes open terminals for adding the appropriate interface.

Range:	0.1-20 A (28 Apk)
Usable Bandwidth:	45 Hz – 3 kHz
Isolation:	Fully Isolated

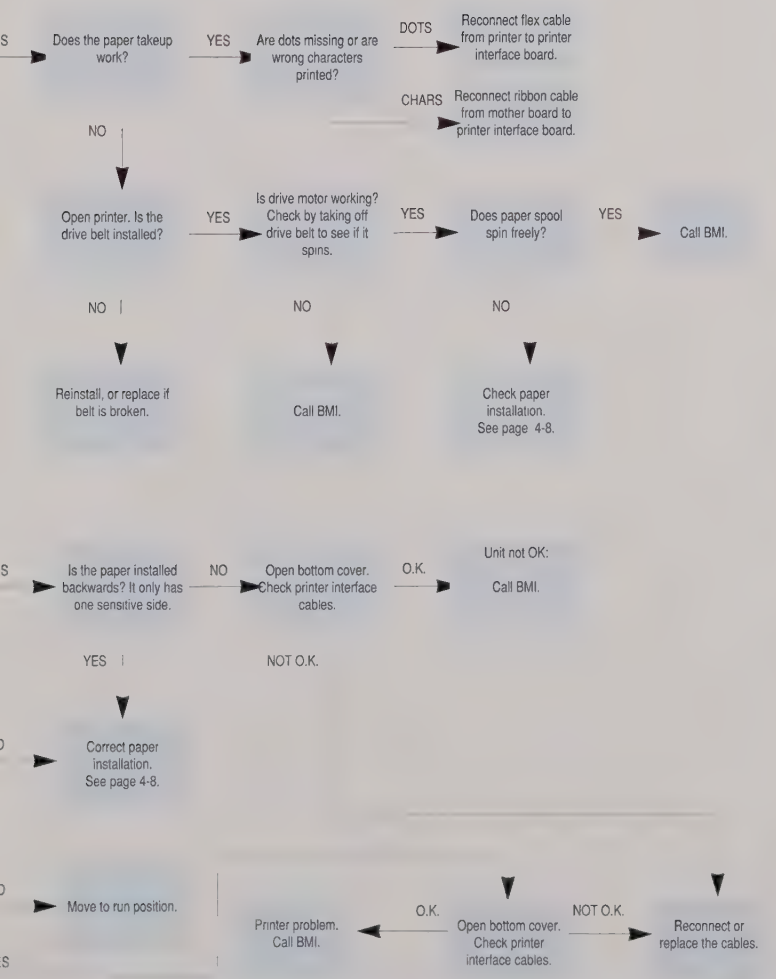
SmartProbes are equipped with safety connectors. Colored O-rings are included for color-coding the safety connector and descriptor module by phase.

Troubleshooting

The chart on the next two pages is provided to assist you in troubleshooting your PowerProfiler. It can help you isolate the exact problem you are having prior to calling BMI Technical Support for assistance. To reach a Technical Support Representative, call 415 570-5355 (Representatives available from 7:30 a.m. to 5:00 p.m., Pacific Standard Time, Monday through Friday, except holidays). Or, fax your questions to BMI Technical Support, 415 574-0583.

Troubleshooting

Press the Help! button at any time for more information


Does the paper takeup work?
YES
Are dots missing or are wrong characters printed?
DOTS
Reconnect flex cable from printer to printer interface board.
CHARS
Reconnect ribbon cable from mother board to printer interface board.
NO
Open printer. Is the drive belt installed?
YES
Is drive motor working? Check by taking off drive belt to see if it spins.
YES
Does paper spool spin freely?
YES
Call BMI.
NO
Reinstall, or replace if belt is broken.
NO
Call BMI.
NO
Check paper installation. See page 4-8.
Is the paper installed backwards? It only has one sensitive side.
NO
Open bottom cover. Check printer interface cables.
O.K.
Unit not OK:
Call BMI.
YES
Correct paper installation. See page 4-8.
NOT O.K.
Move to run position.
Printer problem. Call BMI.
O.K.
Open bottom cover. Check printer interface cables.
NOT O.K.
Reconnect or replace the cables.

Troubleshooting

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Calibration

When should your PowerProfiler or SmartProbes™ be calibrated?
When your PowerProfiler and your SmartProbes are properly calibrated, every graph that prints out will include a BMI logo. The logo will disappear and "uncalibrated data" will appear in its place when:

- The unit has passed its calibration due date
- For some other reason the unit has become uncalibrated
- One or more of your SmartProbes are out of calibration

To identify the reason for uncalibrated data, press the **CALIBRATE** button. The printout will describe the status of your unit and SmartProbes. You will then know what you need to calibrate.

BMI's calibration service
BMI offers full calibration services for any BMI instrument. Calibration is guaranteed and traceable to NIST. Call Technical Support at 415 570-5355 for details on getting your PowerProfiler calibrated at the factory.

Calibrating the PowerProfiler and SmartProbes at your site
The Calibration Menu allows you to do the following:

- Print out a Calibration Status Report
- Calibrate the PowerProfiler's voltage and SmartProbe current inputs
- Calibrate any SmartProbe which you have attached to the PowerProfiler

BMI recommends that you establish a calibration calendar so that your PowerProfiler is calibrated by a designated person at specified times. Calibration will clear all previously calibrated inputs.

Equipment you will need:
1. AC voltage source capable of delivering at least 100 Vrms (such as a Behlman KBT-25-D-362-375-376-451 or Fluke 5200A)
2. An AC current source capable of delivering at least 100 Arms (such as a Valhalla 2555A)
3. Voltmeter/ammeter (5 digit accuracy)
4. 1 SmartProbe channel special connector (See Figure 10.3). Order BMI part number 83001999 from Technical Support.

Print a Calibration Status Report
The Calibration Status Report will show the most recent calibration information on the PowerProfiler and on any SmartProbes which are connected.

Calibration

To print a Calibration Report

1. Press **CALIBRATE**, then the **SCROLL UP** arrow.
2. Use the **VALUE UP/VALUE DOWN** buttons to position "Print Status" in the display.
3. Press the **SCROLL DOWN** arrow. A complete report showing when and who calibrated the PowerProfiler last will print out.

```
POWERPROFILER SITE   Jan 15 1992 (Wed)

CALIBRATION REPORT                8:46 AM

Channel          Offset Stability Status
-------------------------------------------
Phase A volts:      9    0.51%    Good
Phase A amps:      12    0.35%    Good
Phase B volts:      4    0.48%    Good
Phase B amps:       8    0.42%    Good
Phase C volts:      9    0.55%    Good
Phase C amps:       5    0.32%    Good
-------------------------------------------

Calibration passed.
```

Figure 10.1: Calibration Status Report Shows acceptable calibration with good offsets on all channels.

To calibrate your PowerProfiler

1. **Unit warm-up.** Plug your PowerProfiler in and turn it on. Allow the unit to remain on for one hour.
2. **Calibrate offsets.**

   Clear the PowerProfiler. Press **CANCEL PRINTER** followed by the **SCROLL UP** arrow then the **CLEAR** button. All settings will return to the default settings and all stored data will be erased.

   Press **CALIBRATE** then the **SCROLL UP** arrow. You are now in the calibrate mode.

   Use the **VALUE UP/VALUE DOWN** buttons to select the Energy Processor Menu. This is the calibration menu for the PowerProfiler.

   Press the **SCROLL DOWN** arrow and answer the questions in the menu. Use the keypad and **SCROLL UP/SCROLL DOWN** arrows to enter data for "Date due" (date you want to recalibrate in the future), "Calibrated by", and "NIST trace" (Standard Laboratory Trace Number).

   Use the **SCROLL UP/SCROLL DOWN** arrows to choose YES when you reach "Calibrate Offset". The unit will now calibrate offsets. Check for good offsets by printing a Calibration Status Report and checking the Status column. If any of the offsets are not "good", press the **SCROLL UP** arrow and then the **SCROLL DOWN** arrow to repeat the offset measurements. If the unit does not show good offsets after three tries, call BMI Technical Support at 415 570-5355. If the unit shows good offsets, continue calibration.

Calibrate voltage and current inputs

Connect the AC voltage source to the voltage phase inputs of your PowerProfiler. Adjust for at least 100 Vrms at 50/60 Hz. See Figure 10.2 for proper connections. Highest accuracy is achieved if the PowerProfiler is calibrated as close to 400 V as possible. The current range is fixed at 0-3 mA corresponding to the 0-1000 Arms range. An accurate voltage source with an appropriate high value resistance is adequate to produce a reference current.

Press the **SCROLL DOWN** arrow.

Enter the measured voltage value from the PowerProfiler keypad to at least five digits.

Press the **SCROLL DOWN** arrow. The PowerProfiler will calibrate and print out a calibration verification. Verify on the printout that the gain is approximately 1.00 (acceptable range is ±2%)

Repeat for the other two phases. The PowerProfiler will calibrate automatically after each phase.

To calibrate SmartProbe current channel inputs, connect the AC voltage source to the current phase inputs of your PowerProfiler using the SmartProbe channel special connector, BMI part number 83001999. Adjust for at least 100 Vrms (see Figure 10.4).

Multiply the metered current measurement by 333,333.

Enter the calculated current value. The gain will print after the value is entered. Verify that the gain is very close to 1.00 (± 5%).

Press the **SCROLL DOWN** arrow. Repeat for the other two phases.

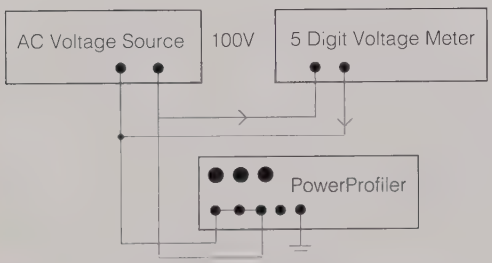


Figure 10.2: Connecting for voltage calibration

Calibration

Calibrating SmartProbes (repeat for each SmartProbe to be calibrated)

Go to the beginning of the Calibration Menu. Choose [Cal: Current Probe]. You will be calibrating each SmartProbe using SmartProbe channel Phase A input only.

Connect the current source as shown in Figure 10.5. A high reference current is needed for SmartProbe calibration. High currents may be obtained from current sources by using extra turns of wire through the SmartProbe jaws. The reference currents in Figure 10.3 are recommended. Highest accuracy is achieved if the probes are calibrated at approximately 70% probe full scale current.

Plug the SmartProbe into Phase A.

Press the **SCROLL DOWN** arrow and use the keypad to enter information about this SmartProbe. Use the keypad and **SCROLL UP/SCROLL DOWN** arrows to enter data for "Date due", "Calibrated by", and "NIST number". Press **SCROLL DOWN** to calibrate.

When calibrating an A-119 or A-121 with a customer-supplied current transformer, ignore current transformer multiplier as above and calibrate, but remember to include a multiplier for field measurements.

Probe	Min	Max	Theoretical Gain
A-115	25 A	60 A	0.100
A-116	250 A	600 A	1.000
A-119	2A	10 A	0.015
A-120	250 A	3000 A	6.000
A-121	2 A	20 A	0.03

Figure 10.3: Recommended reference currents

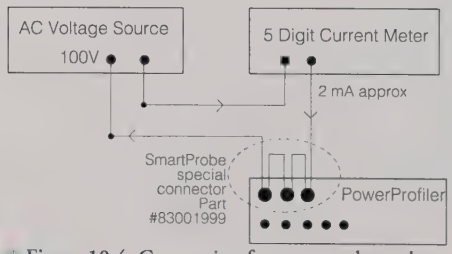
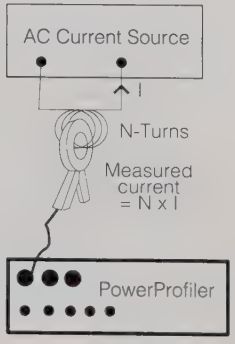


Figure 10.4: Connecting for current channel calibration

Figure 10.5: SmartProbe calibration Multiple turns of wire through the probe creates a high reference current.



Press the Help! button at any time for more information

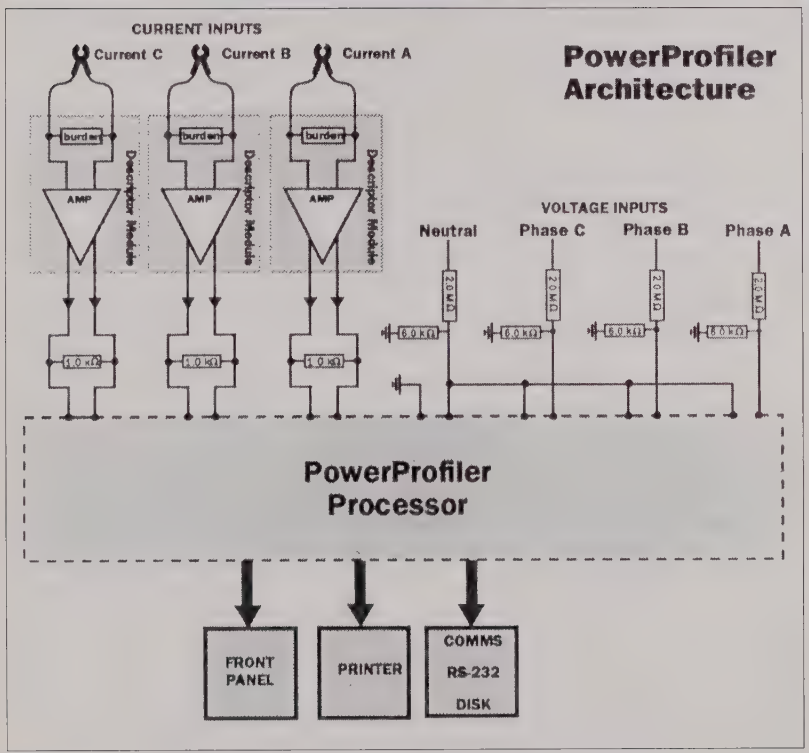


Figure 11.1: PowerProfiler Architecture.

To sample voltage and current simultaneously, four voltage and three current signals are routed through a multiplexer to a 14-bit analog-to-digital converter. For accurate measurements on distorted signals, phase-locking is used to ensure data points are taken from the same location on the waveform for successive cycles. All measurements and calculations are based on 1024 data points per sampling period. The number of data points per cycle and the number of sampled cycles for each channel are shown in the following table.

Frequency	# Data Points/Cycle
25-63 Hz	128
61-125 Hz	64
120-250 Hz	32
240-500 Hz	16

Theory of Operation

Digital data is passed to a CPU (80C186) and a co-processor (80C187) where the 7 x 1024 samples are processed every two seconds for three-phase, every second for single-phase. The CPU controls I/O operations, diskette drive if installed, communications, printer, front panel keyboard, and meters.

Standard PowerProfiler Measurements

From the seven groups of 1024 sampled data points, the PowerProfiler computes its parameters every second for single-phase and every two seconds for three-phase. A Fast-Fourier Transform is performed every two seconds to give the Total Harmonic Distortion (THD), the harmonic spectrum for voltage and current up to the 50th harmonic, and the harmonic power spectrum and direction. Other measurements which depend on the harmonic analysis are also computed, such as displacement power factor (dPF), VARs, telephone interference factor (I•T Product), and transformer derating. The data is automatically reduced by the computer into graphs for ease of understanding.

1. True RMS measurements

The PowerProfiler computes the RMS voltage and current over two cycles 256 data points (two cycles at 60 Hz) and calculates the True RMS value regardless of the shape of the waveform by taking the square root of the mean of the sum of the squares of the data points:

$$V_{rms} = \sqrt{\frac{\sum_{n=0}^{255} V_n^2}{256}} \qquad I_{rms} = \sqrt{\frac{\sum_{n=0}^{255} I_n^2}{256}}$$

2. Average voltage for three-phase

The average voltage for three-phase is calculated in accordance to ANSI MG 1-1987 as:

$$V_{avg} = (V_{Arms} + V_{Brms} + V_{Crms})/3$$

3. Total current for three-phase

The PowerProfiler gives the total RMS current of a three-phase wye system as the sum of the phase currents:

$$I_{total} = I_{Arms} + I_{Brms} + I_{Crms}$$

The total current for a three-phase delta system is:

$$I_{total} = 1.73 \times (I_{Arms} + I_{Brms} + I_{Crms})$$

4. Imbalance

In accordance with ANSI MG 1-1987, the percent imbalance of voltage or current is calculated as:

$$\% \text{ Imbalance} = 100\% \times (\text{max deviation from average/average})$$

5. Apparent Power (VA)

AC power in Volt-Amps (VA) is obtained by multiplying the RMS voltage by the RMS current:

$$VA = V_{rms} \times I_{rms}$$

6. Watts

True power in Watts is computed from the sum of each voltage point multiplied by its corresponding current point, integrated over the first 256 points. The PowerProfiler gives the true power including any harmonic distortion:

$$W = \frac{\sum_{n=0}^{255} V_n \times I_n}{256}$$

7. Power Factor

True Power Factor (PF) is the ratio of true power to apparent power.
This is the true power factor, regardless of any distortion in the voltage and current waveforms.

$$PF = \frac{W}{VA}$$

8. Displacement Power Factor (dPF)

Displacement power factor is the cosine of the displacement between the voltage and the current at the fundamental frequency. The PowerProfiler finds the angle

between the voltage and current at the fundamental by harmonic analysis and then takes the cosine.

$$dPF = \text{Cosine}\ (\theta_{Vfund} - \theta_{Ifund})$$

Note: Power factor or Cos(Ø)?
Many people still think of and refer to Power Factor as Cosine Ø because they were taught that way. The Cosine Ø simplification can only be used for a sine wave (one frequency, no harmonics). Displacement Power Factor is equal to the True Power Factor only for pure sine waves.

9. Reactive power (VAR)
The reactive power in VARs is calculated for the fundamental frequency components of voltage and current:

$$VARs = V_{rms\text{-}fund} \times I_{rms\text{-}fund} \times \text{Sin}\ (\theta_{V\text{-}fund} - \theta_{I\text{-}fund})$$

10. Phasor diagrams
The PowerProfiler prints phasor diagrams at the fundamental frequency for voltage and current. Phasor diagrams are useful for showing phase rotation, imbalance, and verifying the PowerProfiler's voltage and current connections.

Demand Option (P-301) Measurements
1. Efficiency
Two PowerProfilers connected together can measure electrical efficiency of devices such as transformers or uninterruptible power systems (UPS). With an RS-232 cable linking the two instruments, they will automatically calculate efficiency. The master PowerProfiler will report the efficiency in the meter window and print report graphs as required.

$$\text{Efficiency} = \frac{W_{out}}{W_{in}} \times 100\%$$

2. Cash flow
Using rate structures or tariffs power consumption is calculated in terms of cash flow; i.e., how much money is flowing along a conductor. The user enters either a

flat rate or a time-of-day rate structure, and the Powerprofiler will graph the cash flow and keep a running total.

3. Billing demand and sliding interval

The billing demand report graph shows the power the same way that utilities meter power using peak-demand meters which average power consumption over an interval, usually 15 or 30 minutes. The PowerProfiler plots billing demand and accounts for billing demand charges in the cash report. Billing demand intervals between zero and 60 minutes may be programmed.

A variation on the billing demand interval is the sliding window interval when the utility continually moves the interval. The PowerProfiler accommodates slide times from 1 to 5 minutes.

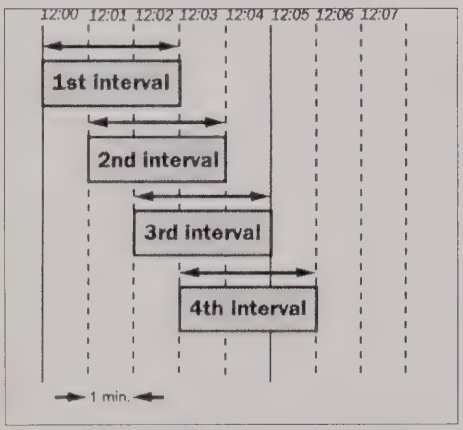


Figure 11.2: Three minute sliding windows

4. Load duration curve

The load-duration curve is a plot of the percentage of peak-demand against the percentage of time that the demand was used.

Harmonic Option (P-302) Measurements

1. Harmonics

Every two seconds (every one second for single-phase) the PowerProfiler performs a harmonic analysis by the Fast Fourier Transform (FFT) method and gives the magnitude and the phase angle of each harmonic up to the 50th harmonic. The

harmonic analysis results are used to calculate the following parameters: Total Harmonic Distortion, transformer derating, telephone interference factor (I•T Product), and sequencing (positive, zero, and negative sequences for voltage and current.)

2. Total Harmonic Distortion (THD)
THD is calculated as follows:

$$(12) \quad V_{THD} = \frac{\sqrt{\sum_{n=2}^{50} h_n^2}}{h_1} \times 100\%$$

3. Transformer Derating Factor
At 180 Hz the efficiency of a transformer drops from 96% to 70% and is lower with higher frequency. Current harmonics can overheat and even destroy transformers. An algorithm has been developed (ANSI/IEEE C57.110-1986, 5.3) which gives a "derating factor" to determine the maximum permitted load taking the harmonics into account. The PowerProfiler calculates derating using this algorithm. The user supplied % Eddy current loss must be entered in the Harmonics Menu.

4. Telephone Interference Factor (I•T Product)
The I•T Product, based on IEEE 519, weights each current harmonic according to the band-pass characteristics of telephone systems and the frequency response of the human ear. The PowerProfiler calculates the I•T Product as:

$$I \bullet T = [\sum_{n=1}^{H} (I_n T_n)^2]^{1/2}$$

where Tn = telephone interference weight factor from tables in IEEE 519

5. Harmonic Power Direction
The PowerProfiler also finds the direction of flow of harmonic power for each harmonic using harmonic phase angle information.

6. Positive, Zero, and Negative Sequences
The PowerProfiler calculates and displays in the meter window positive, negative, and zero sequences for voltage and current at the fundamental frequency.

Neutral Option (P-303) Measurements—
Neutral Voltage and Current

The PowerProfiler measures the actual neutral-to-ground voltage (when there is one) and calculates the neutral current from the phase currents. This is valid when there is no leakage in the system. To confirm the actual neutral current the instrument can be set up for single-phase and the current measurement made on the neutral conductor. If the Harmonic Option Package P-302 is installed, the PowerProfiler will calculate the neutral current harmonic spectrum.

Note: Three-phase delta metering neutral

There are four voltage inputs and a ground connection terminal to the PowerProfiler. In applications where no neutral conductor exists – as in a three-phase-delta configuration – the PowerProfiler references the measurements to ground. Using software, the PowerProfiler constructs a metering neutral at the center of the three phases. A metering neutral is a mathematical neutral used to calculate power measurements in a delta system. Also, in delta configurations the PowerProfiler can calculate the third phase current if it knows the other two currents.

SmartProbe Measurements

The PowerProfiler uses SmartProbes to measure current. SmartProbes are up to ten times more accurate than conventional current probes. Each SmartProbe consists of a current transformer and a descriptor module. Inside the descriptor module is a programmable precision current source. The gain of the current source is adjusted to compensate for any deviations in current transformer output as result of the transformer manufacturing process or variations in burden and cable resistance. The descriptor module precisely calibrates the current transformer and provides the correct levels to the PowerProfiler. Four SmartProbes are available with full-scale measuring ranges of 20, 60, 600, and 3000 amps.

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Specifications

Accuracy

	Accuracy at 50/60 Hz	Useful Bandwidth
Voltage Accuracy:	±0.01% full scale ±0.1% of reading	DC - 3 kHz
Current Accuracy:		
A-115 (1-60 Arms)	±0.03% of full scale ±0.1% of reading	50 Hz - 1 kHz
A-116 (10-600 Arms)	±0.01% of full scale ±0.1% of reading	50 Hz - 3 kHz
A-120 (10-3000 Arms)	±0.01% of full scale ±0.1% of reading	30 Hz - 3 kHz
A-121 (0.1-20 Arms)	±0.02% of full scale ±0.2% of reading	45 Hz - 3 kHz

Ranges

	Voltage	Current
Without multiplier	0.1 - 600 Vrms (±1000 Vpk)	0.1 - 3000 Arms
With multiplier	<0.1 mV - 6 GV	<0.1 mA - 30 GA
User-supplied multipliers for use with CTs and PTs	.000001 - 9,999,999	.000001 - 9,999,999
Fundamental Frequency (for harmonic analysis)	25 - 450 Hz	25 - 450 Hz

* Refer to the Input Voltage Operating Ranges table on page 2-7 for correct line voltage selector settings.

General

Physical	14.6 x 13.0 x 5.7 in (37 x 33 x 14.5 cm) (L x W x H)	17 lb (7.6 kg)
Power	120/220/240 VAC, 50/60/400 Hz, 100 VA MAX* UPS: internal nicad batteries, 15 minutes	
Environmental	Temperature	Humidity
Operating	0° C to 50° C	95% noncondensing
Storage	-40° C to 75° C	95% noncondensing
Testing, approvals	CSA, UL pending	

Input Characteristics

	Voltage	Current
Type	solid state differential DC coupled	BMI SmartProbe with software calibration and amplifier in probe
Impedance	2 MΩ to ground <50 pF to ground	
Dielectric	>2.5 kV to chassis	
Connectors	standard high voltage safety connectors	BMI SmartProbe

Specifications at 20°C, 50/60 Hz, 5% full scale to 60% full scale. Temperature coefficient ±200 ppm/°C, drift less than 10 ppm/day full scale, noise less than 0.05% Rms full scale, resolution ±0.5 display count. Warmup time to rated accuracy is 60 minutes.

Specifications subject to change without notice.

Specifications

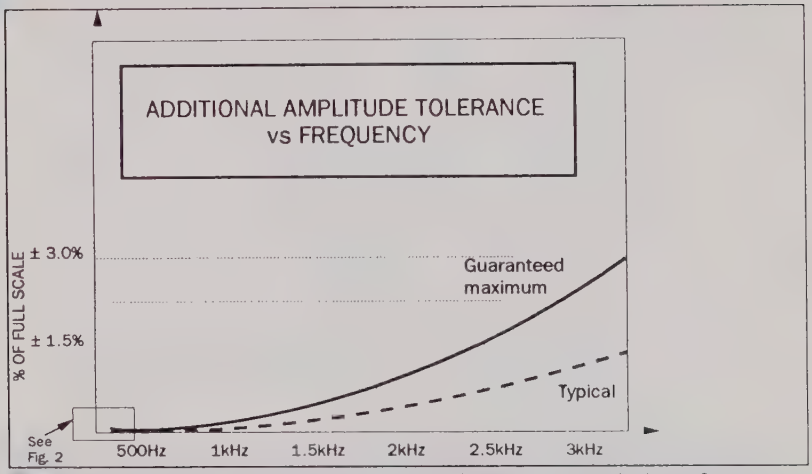

Figure 12-1: Amplitude Error vs Frequency. Add tolerance to standard specification. Applies to voltage channel, A-116, A-120 SmartProbes. Conditions: phase-locked signal, amplitude at frequency of interest > 10% full-scale, ± 0.5 display digit, firmware revision 3.0 or later, current conductor centered in jaw. A-115 not specified.

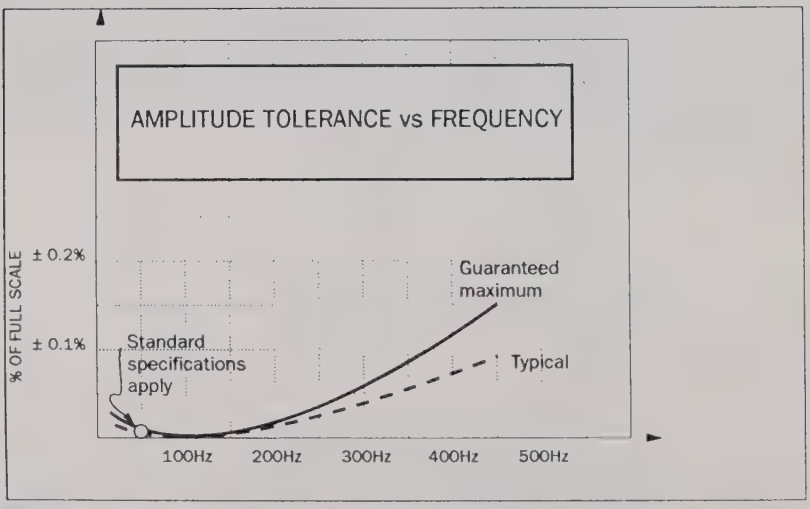

Figure 12-2: Amplitude Error vs Frequency. Enlarged view of boxed area in Figure 12-1.

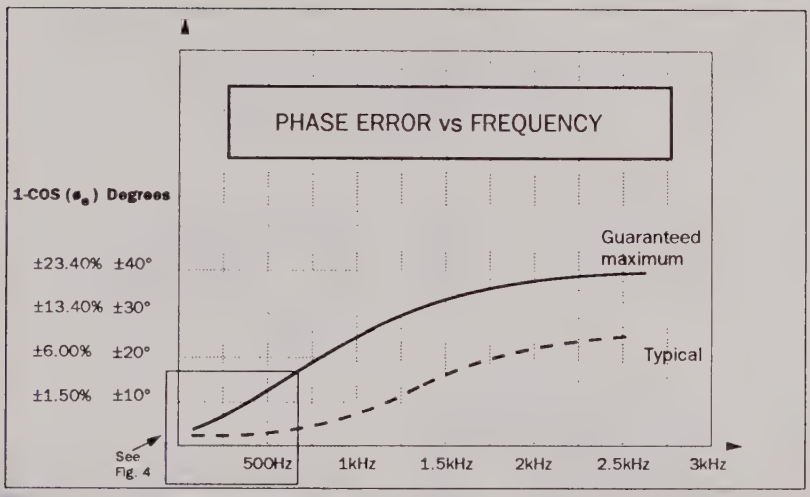

Figure 12-3: Phase error vs frequency. Applies to voltage channels, A-116, A-120 SmartProbes. Conditions: phase-locked signal, amplitude at frequency of interest > 10% full-scale, ± 0.5 display digit, firmware revision 3.0 or later, current conductor centered in jaw. A-115 not specified.

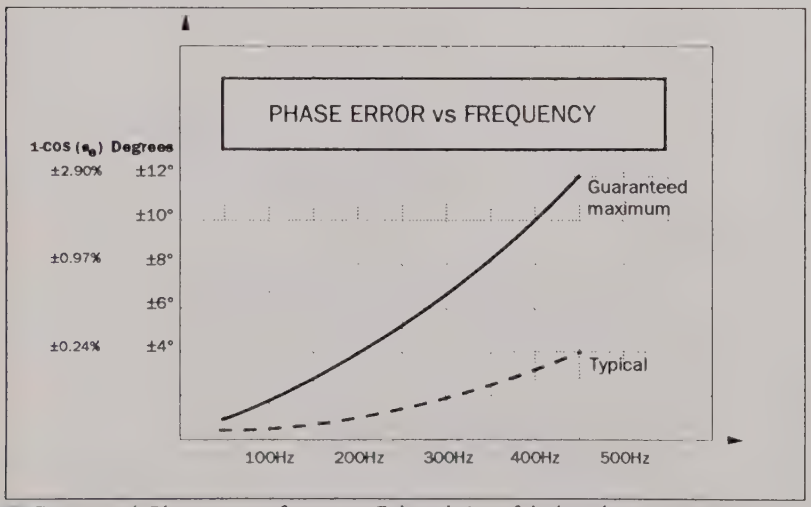

Figure 12-4: Phase error vs frequency. Enlarged view of the boxed area in Figure 12-3.

Specifications

Sources of SmartProbe current errors

The principal sources of current measurement errors with A-116 and A-120 SmartProbes are conductor position, conductor angle, and mating of clamp-on jaw. The descriptions below apply to the A-116, but the principles apply to all clamp-on current probes.

Conductor Position

The A-116 SmartProbe has its accuracy specified with the conductor positioned in the center of the jaws (position X in figure 1). The following diagram and graph show how the accuracy varies with conductor position for the A-116 600 Amp SmartProbe.

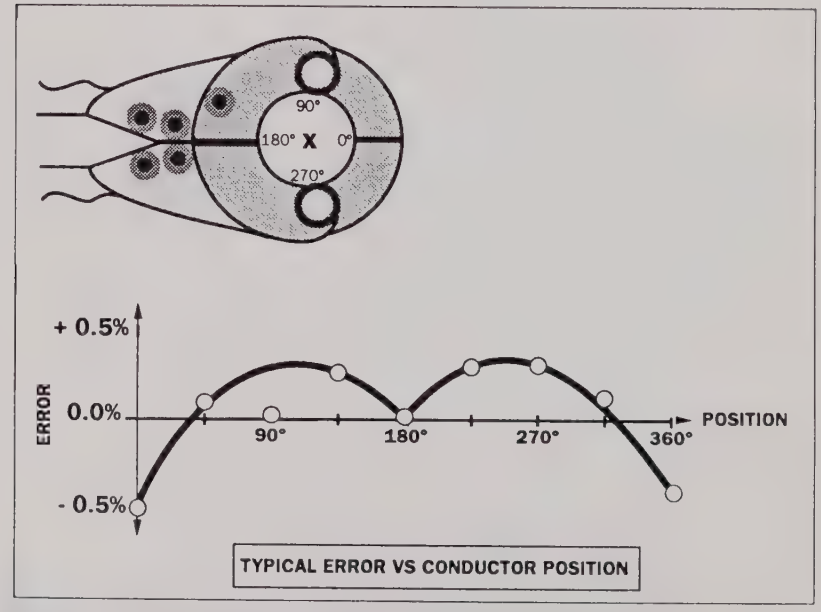

Figure 12-5: Typical Error vs Conductor Position. With the following test qualifications:

- A-116 SmartProbe, calibrated at 200A, 60Hz
- Error expressed as percent of reading
- Test @ 16A, 60 Hz
- Conductor perpendicular to plane of jaw
- Normalized to centered conductor = 0.0%

Conductor Angle

The A-116 SmartProbe has its accuracy specified with the conductor positioned at 90° to the jaws. The following diagram and graph show how the error varies with conductor angle.

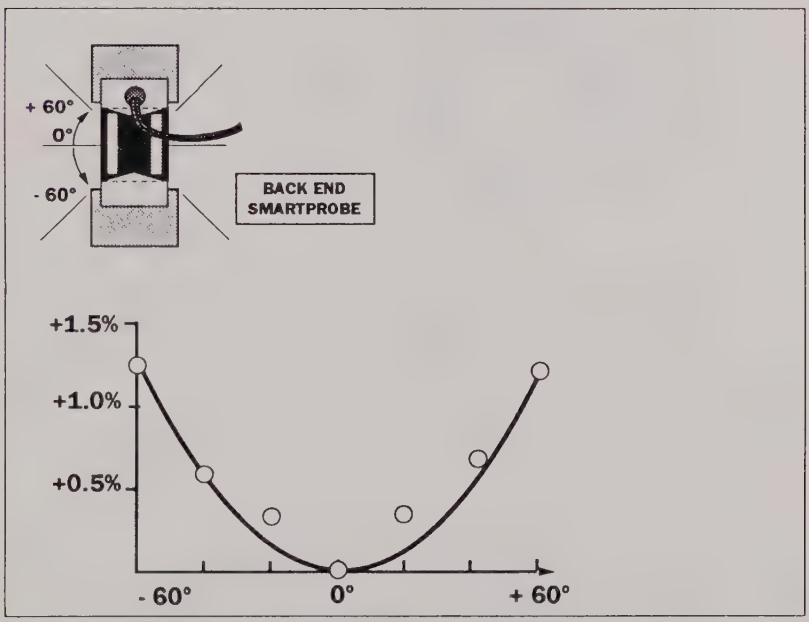

Figure 12.6: Error vs Conductor Angle

- A-116 SmartProbe, calibrated @ 200 A, 60 Hz
- Test @ 20A, 60 Hz
- Conductor passes through center point of jaw
- Error as percent of reading

Specifications

Mating of Clamp-On Jaw

Errors will also be introduced if the jaws do not mate properly. The following graph shows how the error varies with the gap between jaws for the A-116 600 amp SmartProbe.

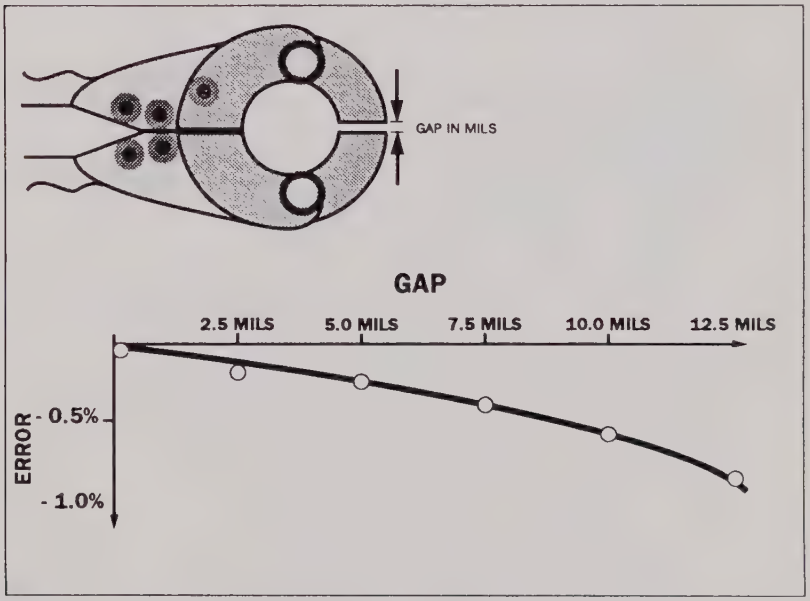

Figure 12.7: Typical Error vs Jaw Gap

- A-116 SmartProbe, calibrated @ 200A, 60Hz
- Error as percent of reading
- Test @ 16A, 60Hz, normalized to 0.0% @ ø gap

Supplies and Accessories

Starter Kits

S-303
2 cases (24 rolls) thermal paper, G-201 Carry Bag.

S-305
2 cases (24 rolls) thermal paper, G-201 Carry Bag, W-303 warranty extension.

S-307
2 cases (24 rolls) thermal paper, G-201 Carry Bag, box of 10 diskettes.

S-365
2 cases (24 rolls) thermal paper, G-201 Carry Bag, box of 10 diskettes, W-306 warranty extension.

Supplies/Accessories

A-017
PanelProbe
Power cord - enables direct connection to distribution panel (240 Vrms max).

A-036
Cable Set
PowerProfiler cable set on a pallet (1 each red, blue, yellow, white, green/yellow, power cord, single-phase test lead).

A-201
Rack Mount
19" rack mount for PowerProfiler.

A-311
PowerProfiler User's Guide

A-600
Parallel Printer
PC-compatible dual-diskette storage for 1,400 graphs; performs THD and spectrum analysis with 4800 and 2400 PowerScopes. Includes PowerTalk.

G-010
PowerTalk Software
Supplied on 3.5" and 5.25" diskettes. Includes Export, cables, and User's Guide.

G-012
Cart
Transports shipping case and luggage.

G-201
Carry Bag
Soft-side canvas-type material with large front pocket and 2 large side pockets.

G-202
Shipping Container
Rugged orange container for PowerProfiler.

S-201
Thermal Paper
2" wide, 12 rolls.

S-502
Takeup Spools
Box of 100 for internal paper takeup system.

S-601
Diskettes
Box of 10 3.5" blank data diskettes.

Supplies and Accessories

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Single-Phase Meter Tree

Phase A-N: 0.0 V	Neut-Gnd: 0.0 V *
Phase A: 0.0 A	<—Current—>
Phase A-N: 0.0 W	<—Power—>
Phase A-N: 0.0 VA	<—Volt_Amps—>
Phase A-N: 0.0 VAR	<—VA Reactive—>
Phase A-N: 0.0 PF	<—Power Factor—>
Phase A-N: 0.0 dPF	<—Disp. Factor—>
A Current Lags: 0°	<—Curr lead/lag—>
A-N Volts: 0.0% THD	<—Volt THD—>
A Current 0.0% THD	<—Curr THD—>
Derate xfmr to: 0% **	<—Derate xfmr—>
A I*T Product: 0 k **	<—Curr TIF—>
A harmonic #1 **	<—Harmonics—>
A harmonic #2 **	<—Harmonics—>
A harmonic #3 **	<—Harmonics—>
A harmonic #4 **	<—Harmonics—>
Capacity: 0.0% Cap •	<—Capacity—>
Efficiency: 0.0% Eff •	<—Efficiency—>
Cost: $0.000 /Hr •	<—Cost—>
Frequency: 60.0 Hz	<—Frequency—>
Time: hh/mm/ss	Time: hh/mm/ss

* Only available with P-303 Neutral Option

** Only available with P-302 Harmonics Option

• Only available with P-301 Demand Option

Appendix

Single-Phase, 3 Wire Meter Tree

Average: 0.0 V	Phase A-N: 0.0 V	Phase B-N: 0.0 V	Neut-Gnd: 0.0 V *	V Imbalance: 0.0%
Total: 0.0 A	Phase A: 0.0 A	Phase B: 0.0 A	Neutral: 0.0 A *	A Imbalance: 0.0%
Total: 0.0 W	Phase A-N. 0.0 W	Phase B-N: 0.0 W	<—Power—>	<—Power—>
Total: 0.0 VA	Phase A-N: 0.0 VA	Phase B-N: 0.0 VA	<—Volt-Amps—>	<—Volt-Amps—>
Total: 0.0 VAR	Phase A-N: 0.0 VAR	Phase B-N: 0.0 VAR	<—VA Reactive—>	<—VA Reactive—>
Total: 0.0 PF	Phase A-N: 0.0 PF	Phase B-N: 0.0 PF	<—Power Factor—>	<—Power Factor—>
Total: 0.0 dPF	Phase A-N: 0.0 dPF	Phase B-N: 0.0 dPF	<—Disp. Factor—>	<—Disp. Factor—>
<—Curr lead/lag—>	A Current Lags: 0°	B Current Lags: 0°	<—Curr lead/lag—>	<—Curr lead/lag—>
Avg. Volts: 0.0% THD	A-N Volts: 0.0% THD	B-N Volts: 0.0% THD	<—Volt THD—>	<—Volt THD—>
Avg. Curr: 0.0% THD	A Current: 0.0% THD	B Current: 0.0% THD	N Current: 0.0% THD *	<—Curr THD—>
Derate xfmr to: 0% **	<—Derate xfmr—> **	<—Derate xfmr—> **	<—Derate xfmr—> **	<—Derate xfmr—> **
I*T Product: 0 k **	A I*T Product: 0 k **	B I*T Product: 0 k **	<—Curr TIF—> **	<—Curr TIF—> **
Avg harmonic #1 **	A harmonic #1 **	B harmonic #1 **	<—Harmonics—> **	<—Harmonics—> **
Avg harmonic #2 **	A harmonic #2 **	B harmonic #2 **	<—Harmonics—> **	<—Harmonics—> **
Avg harmonic #3 **	A harmonic #3 **	B harmonic #3 **	<—Harmonics—> **	<—Harmonics—> **
Avg harmonic #4 **	A harmonic #4 **	B harmonic #4 **	<—Harmonics—> **	<—Harmonics—> **
Total: 0.0% Cap •	<—Capacity—>•	<—Capacity—>•	<—Capacity—>•	<—Capacity—>•
Total: 0.0% Eff•	<—Efficiency—>•	<—Efficiency—>•	<—Efficiency—>•	<—Efficiency—>•
Cost: $0.000 /Hr•	<—Cost—>•	<—Cost—>•	<—Cost—>•	<—Cost—>•
Frequency 60.0 Hz	<—Frequency—>	<—Frequency—>	<—Frequency—>	<—Frequency—>
Time: hh/mm/ss	Time: hh/mm/ss	Time: hh/mm/ss	Time. hh/mm/ss	Time: hh/mm/ss

* Only available with P-303 Neutral Option

** Only available with P-302 Harmonics Option

• Only available with P-301 Demand Option

Three-Phase, 3 Wire Meter Tree

Average: 0.0 V	Phase A-B: 0.0 V	Phase B-C: 0.0 V	Phase C-A: 0.0 V	V Imbalance: 0.0%
Total: 0.0 A	Phase A: 0.0 A	Phase B: 0.0 A	Phase C: 0.0 A	A Imbalance: 0.0%
Total: 0.0 W	<—Power—>	<—Power—>	<—Power—>	<—Power—>
Total: 0.0 VA	<—Volt_Amps—>	<—Volt_Amps—>	<—Volt_Amps—>	<—Volt_Amps—>
Total: 0.0 VAR	<—VA Reactive—>	<—VA Reactive—>	<—VA Reactive—>	<—VA Reactive—>
Total: 0.0 PF	<—Power Factor—>	<—Power Factor—>	<—Power Factor—>	<—Power Factor—>
Total: 0.0 dPF	<—Disp. Factor—>	<—Disp. Factor—>	<—Disp. Factor—>	<—Disp. Factor—>
<—Curr lead/lag—>	A Current Lags: 0°	B Current Lags: 0°	C Current Lags: 0°	<—Curr lead/lag—>
Volt Pos Seq: 0.0% **	Volt Zero Seq: 0.0% **	Volt Neg Seq: 0.0% **	<—Volt Seq—> **	<—Volt Seq—> **
Curr Pos Seq: 0.0% **	Curr Zero Seq: 0.0% **	Curr Neg Seq: 0.0% **	<—Curr Seq—> **	<—Curr Seq—> **
Avg. Volts: 0.0% THD	A-Nm Volt: 0.0% THD	B-Nm Volt: 0.0% THD	C-Nm Volt: 0.0% THD	<—Volt THD—>
Avg. Curr: 0.0% THD	A Current: 0.0% THD	B Current: 0.0% THD	C Current: 0.0% THD	<—Curr THD—>
Derate xfmr to: 0% **	<—Derate xfmr—> **	<—Derate xfmr—> **	<—Derate xfmr—> **	<—Derate xfmr—> **
I*T Product: 0 k **	A I*T Product: 0 k **	B I*T Product: 0 k **	C I*T Product: 0 k **	<—Curr TIF—> **
Avg harmonic #1 **	A harmonic #1 **	B harmonic #1 **	C harmonic #1 **	<—Harmonics—> **
Avg harmonic #2 **	A harmonic #2 **	B harmonic #2 **	C harmonic #2 **	<—Harmonics—> **
Avg harmonic #3 **	A harmonic #3 **	B harmonic #3 **	C harmonic #3 **	<—Harmonics—> **
Avg harmonic #4 **	A harmonic #4 **	B harmonic #4 **	C harmonic #4 **	<—Harmonics—> **
Total: 0.0% Cap •	<—Capacity—>•	<—Capacity—>•	<—Capacity—>•	<—Capacity—>•
Total: 0.0% Eff•	<—Efficiency—>•	<—Efficiency—>•	<—Efficiency—>•	<—Efficiency—>•
Cost: $0.000 /Hr•	<—Cost—>•	<—Cost—>•	<—Cost—>•	<—Cost—>•
Frequency 60.0 Hz	<—Frequency—>	<—Frequency—>	<—Frequency—>	<—Frequency—>
Time: hh/mm/ss	Time: hh/mm/ss	Time: hh/mm/ss	Time: hh/mm/ss	Time: hh/mm/ss

* Only available with P-303 Neutral Option

** Only available with P-302 Harmonics Option

• Only available with P-301 Demand Option

Appendix

Three-Phase, 4 Wire Meter Tree

Average: 0.0 V	Phase A-N: 0.0 V	Phase B-N: 0.0 V	Phase C-N: 0.0 V	Neut-Gnd: 0.0 V *	V Imbalance: 0.0%
Total: 0.0 A	Phase A: 0.0 A	Phase B: 0.0 A	Phase C: 0.0 A	Neutral: 0.0 A *	A Imbalance: 0.0%
Total: 0.0 W	Phase A-N: 0.0 W	Phase B-N: 0.0 W	Phase C-N: 0.0 W	<—Power—>	<—Power—>
Total: 0.0 VA	Phase A-N: 0.0 VA	Phase B-N: 0.0 VA	Phase C-N: 0.0 VA	<—Volt_Amps—>	<—Volt_Amps—>
Total 0.0 VAR	Phase A-N 0.0 VAR	Phase B-N: 0.0 VAR	Phase C-N: 0.0 VAR	< VA Reactive—>	<—VA Reactive—>
Total: 0.0 PF	Phase A-N 0.0 PF	Phase B-N: 0.0 PF	Phase C-N: 0.0 PF	<—Power Factor—>	<—Power Factor—>
Total. 0.0 dPF	Phase A-N: 0.0 dPF	Phase B-N: 0.0 dPF	Phase C-N: 0.0 dPF	<—Disp. Factor—>	<—Disp Factor—>
<—Curr lead/lag—>	A Current Lags: 0°	B Current Lags: 0°	C Current Lags: 0°	<—Curr lead/lag—>	<—Curr lead/lag—>
Volt Pos Seq: 0.0% **	Volt Zero Seq: 0.0% **	Volt Neg Seq: 0.0% **	<—Volt Seq—> **	<—Volt Seq—> **	<—Volt Seq—> **
Curr Pos Seq. 0.0% **	Curr Zero Seq: 0.0% **	Curr Neg Seq: 0.0% **	<—Curr Seq—> **	<—Curr Seq—> **	<—Curr Seq—> **
Avg. Volts: 0.0% THD	A-N Volt: 0.0% THD	B-N Volt: 0.0% THD	C-N Volt: 0.0% THD	<—Volt THD—>	<—Volt THD—>
Avg Curr. 0.0% THD	A Current 0.0% THD	B Current: 0.0% THD	C Current: 0.0% THD	N Current. 0.0% THD	<—Curr THD—>
Derate xfmr to: 0% **	<—Derate xfmr—> **	<—Derate xfmr—> **	<—Derate xfmr—> **	<—Derate xfmr —> **	<—Derate xfmr—> **
I*T Product. 0 k **	A I*T Product: 0 k **	B I*T Product: 0 k **	C I*T Product: 0 k **	<—Curr TIF—> **	<—Curr TIF—> **
Avg harmonic #1 **	A harmonic #1 **	B harmonic #1 **	C harmonic #1 **	<—Harmonics—> **	<—Harmonics—> **
Avg harmonic #2 **	A harmonic #2 **	B harmonic #2 **	C harmonic #2 **	<—Harmonics—> **	<—Harmonics—> **
Avg harmonic #3 **	A harmonic #3 **	B harmonic #3 **	C harmonic #3 **	<—Harmonics—> **	<—Harmonics—> **
Avg harmonic #4 **	A harmonic #4 **	B harmonic #4 **	C harmonic #4 **	<—Harmonics—> **	<—Harmonics—> **
Total: 0.0% Cap •	<—Capacity—> •	<—Capacity—> •	<—Capacity—> •	<—Capacity—> •	<—Capacity—> •
Total: 0.0% Eff •	<—Efficiency—> •	<—Efficiency—> •	<—Efficiency—> •	<—Efficiency—> •	<—Efficiency—> •
Cost: $0.000 /Hr •	<—Cost—> •	<—Cost—> •	<—Cost—> •	<—Cost—> •	<—Cost—> •
Frequency 60.0 Hz	<—Frequency—>	<—Frequency—>	<—Frequency—>	<—Frequency—>	<—Frequency—>
Time: hh/mm/ss	Time. hh/mm/ss	Time hh/mm/ss	Time: hh/mm/ss	Time: hh/mm/ss	Time hh/mm/ss

* Only available with P-303 Neutral Option

** Only available with P-302 Harmonics Option

• Only available with P-301 Demand Option

Average
When measuring more than one phase, the average voltage or current for all phases is the sum of the individual phases divided by the number of phases.

Capacity
The fraction of a supply's resources that are being used, expressed as a percentage of capacity in amps, volt-amps, watts, or VAR. The user enters both the units of capacity and the total capacity in the Setup Menu. Displayed in meter readings and Summaries.

Cash Flow
The cost per hour (expressed in dollars, yen, pounds, francs, or user-selected designation) of the power flowing in the conductor or conductors being measured by the PowerProfiler. Requires user input of price information such as a utility rate structure entered in the Rate Structure Menu. Displayed in meter readings, Summaries, and Power Consumption report.

Crest Factor
The ratio of the peak instantaneous voltage or current to the RMS voltage or current. For a sine wave, this is approximately 1.4. Crest factors either higher or lower than 1.4 imply the presence of harmonics. Displayed in Voltage & Current snapshot.

Current
True RMS currents – that is, the root of the mean of the sum of the squares of the instantaneous current – gives correct readings for sine waves, distorted waveforms, offset waveforms, and DC (with DC probes). True RMS measurements are necessary to determine additional power parameters accurately. In a single-phase, 3-wire or three-phase, 4-wire system the total current is the sum of the individual phase currents. In a three-phase, 3-wire system, the total current is 1.73 times the average current. Displayed in meter readings, Voltage & Current snapshot, and Power Consumption report and snapshot.

Demand
In its simplest form, demand is the rate of energy consumption (power) measured in watts. A demand interval (typically 15 or 30 minutes) is the average power consumed during the interval. A sliding demand interval advances the beginning and end points of the interval. Utility companies typically choose sliding intervals between 1 and 5 minutes. The demand interval is set in the Rate Structure Menu. Demand is shown in the Power Consumption report.

Glossary

dPF (Displacement Power Factor - Cosine θ)
The cosine of the angle between the fundamental voltage and the fundamental current. Displayed in meter readings, Summaries, and Power Factor report. This is a traditional approximation of the true power factor; however, it is inaccurate for distorted waveforms.

Efficiency
The power efficiency of a system, expressed in percent. If 8 megawatts feeds into a distribution transformer, and 7.6 megawatts comes out, the transformer is 95% efficient. (Note: this measurement requires two PowerProfilers; see chapter 4, page 32 for efficiency setup and report information). Displayed in meter readings, Summaries, and Efficiency report and snapshot.

Form Factor
The ratio of root-mean-square (RMS) voltage or current to average voltage or current. For example, a sine wave has a form factor of 1.1, while a square sine wave has a form factor of 1.0. Displayed in meter readings and Summaries.

Harmonic Spectrum
The harmonic spectrum shows the magnitude of each harmonic frequency that makes up a distorted waveform. The magnitude of each harmonic frequency can be expressed as a percentage of the fundamental, a percent RMS, a percent total current, or as a voltage or current value. The harmonic spectrum also shows how far each frequency is shifted by phase angle with respect to the voltage fundamental. Displayed in Harmonic snapshot.

The magnitude of up to four individual harmonics may be selected for study. This is useful for sizing harmonic filters. Individual harmonic magnitudes are displayed in meter readings and Harmonic reports.

Imbalance
A measure of the difference between RMS voltage (or current) in each phase in percent. The percent imbalance is: % Imbalance = 100% x (max deviation from average/average). For example, if each phase is carrying the same current, and each phase is 120° from adjacent phases, the current is "perfectly balanced" and the current imbalance is 0%. Displayed in Voltage & Current snapshot and report. It is possible in 3-phase systems to have imbalance: e.g., when one phase is lightly loaded.

Load Duration Curve
A curve showing the relationship between peak demand and time or over an hour, day , week, or month. This is useful to show how much load could be shifted to

reduce the peak demand or how much interruptible capacity is available. Displayed in Power Consumption report.

Metering Neutral (Nm)
The metering neutral is a mathematically calculated reference point on a 3-phase 3-wire system. It is used to calculate power and phase angles on individual phases. It is independent of the grounding scheme; it works equally well with corner-grounded, center-grounded, and mid-phase grounded systems. Without it, voltages and currents cannot be associated; for example, should Phase A and Phase B voltage be associated with the current Phase A, or the current in Phase B? A metering neutral allows calculations to be made on the Phase A to metering neutral voltage, which is always associated with the Phase A current.

Phasor Diagrams
A graphic representation of the relationship between phase and amplitude for poly-phase voltages or currents. Applies to the fundamental voltage and current only. Displayed in Voltage & Current snapshot.

Quantity (Qh)
Q is an arbitrary measurement unit used by some utilities in Q-Hour meters instead of kWh meters. Q-Hour meters shift currents by 60° leading to obtain more accurate measurements of kVA and VAR when power factor is between 0.9 and unity.

I•T Product
This is equivalent to the frequency spectrum of the voltage (or current) waveform, weighted according to the response of the telephone system and the human ear. It is a partial measure of how likely a distorted utility voltage waveform will interfere with a telephone system and is based on IEEE 519 data. Values less than 10K (K = 1,000) are unlikely to interfere; values from 10K to 50K may interfere; values greater than 50K probably will interfere with local telephone operation. The PowerProfiler calculates the I•T Product due to current. The voltage I•T Product couples through electric fields and is not usually a problem in a low voltage industrial facility. The current I•T Product couples through magnetic fields, and is especially important near high harmonic loads such as arc welders, adjustable speed drives, UPS's, etc. Displayed in meter readings.

Transformer Derating (eddy current loss)
Harmonic currents may cause a temperature rise in a transformer that is above operating specifications (usually 55°C or 65°C). The transformer must then carry less current to bring the temperature within specified limits. The process that identifies the amount of power available for carrying loads within the specified

temperature is called transformer derating and is based on ANSI C57.110. This reads as a percent figure on the PowerProfiler (e.g., 80% means the transformer can only operate at 80% nameplate capacity to keep within temperature specfications).

Note that transformers can sometimes operate satisfactorily at higher than specified temperature rises for short periods of time (usually 2 hours in an eight hour period, or 8 hours in a 24 hour period) without affecting insulation life. Continuous operation at higher temperatures will result in shorter economic life. Consult the manufacturer for specifics. Displayed in meter readings.

True Power Factor (true PF)
Watts divided by volt-amps. The true power factor will be substantially different from the displacement power factor (cosine θ) when there are large non-linear loads or harmonics present. Displayed in meter readings and Power Factor report and snapshot.

Total Harmonic Distortion (THD)
A percentage describing how much a measured waveform differs from an ideal sine wave. Displayed in meter readings and Harmonics report and snapshot.

VA
True RMS voltage multiplied by true RMS current. Determines the size and cost of end-use distribution systems (bus ducts, transformers, etc.) at any level and location. It is a factor in high harmonics and/or low power factor, especially with ASDs (adjustable speed drives), motor controllers, computers, arc welders, process controllers, etc. Displayed in meter readings and Power Consumption report.

Voltage
True RMS voltage – that is, the root of the mean of the sum of the squares of the instantaneous voltage – gives correct readings for sine waves, distorted waveforms, offset waveforms, and DC. Displayed in meter readings and the Voltage & Current report and snapshot.

Watts (instantaneous power)
The integral of true instantaneous power divided by the sample interval. Displayed in meter readings and Power Consumption report and snapshot.

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